Canadian Transport Commission
Commission canadienne des transports

Railway Transport Committee
Comité des transports par chemin de fer

A DECISION PERTAINING TO CABOOSELESS TRAIN OPERATIONS ON CANADIAN NATIONAL AND CANADIAN PACIFIC RAILWAYS

Commissioner J.F. Walter
Chairman

Commissioner R.J. Orange

December 1987

Canada

Commission canadienne des transports | Canadian Transport Commission

CANADIAN TRANSPORT COMMISSION

RAILWAY TRANSPORT COMMITTEE

ORDER NO. R-41338

December 14, 1987

IN THE MATTER OF an application filed by Canadian Pacific Limited, for approval of amendments to Rules 19, 19A, 90A and 102 of the Canadian Transport Commission's Regulations No. 0-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175;

IN THE MATTER OF an application filed by the Canadian National Railway Company for relief from Rule 90A of the Canadian Transport Commission's Regulations No. 0-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175;

IN THE MATTER OF tests, conducted to evaluate the reliability of the end-of-train unit and associated devices and to evaluate the risks associated with train operation without rear train crew, required by the Railway Transport Committee pursuant to its decision of September 16, 1985 which dealt with the matter of testing cabooseless trains;

IN THE MATTER OF Order No. R-41300 dated December 14, 1987.

File Nos.: 4357R90-A.1
4357R90-A.2

WHEREAS the evidence indicates that all spring switches on CN and CP are signalled;

WHEREAS paragraph 3 of Rule 104A of the Uniform Code of Operating Rules, C.R.C. 1978, c. 1175, requires that trains or engines must stop and examine main track spring switches before making facing point movements over them unless receiving a signal indication permitting them to proceed and thereby provides the protection intended by paragraph 1.31 of RTC Order No. R-41300.

THEREFORE

The Railway Transport Committee hereby amends RTC Order No. R-41300 dated December 14, 1987 by deleting paragraph 1.31 thereof.

Signed this 14th day of December, 1987.

John O'Hara

John O'Hara
Secretary
Railway Transport Committee

Canada

Commission canadienne des transports | Canadian Transport Commission

COMMISSION CANADIENNE DES TRANSPORTS

COMITÉ DES TRANSPORTS PAR CHEMIN DE FER

ORDONNANCE N° R-41338

le 14 décembre 1987

RELATIVE à une requête déposée par Canadien Pacifique Limitée en vue de faire approuver des modifications des règles 19, 19A, 90A et 102 du Règlement n° 0-8 de la Commission canadienne des transports, le Règlement unifié d'exploitation, C.R.C. de 1978, chap. 1175;

RELATIVE à une requête déposée par la Compagnie des chemins de fer nationaux du Canada en vue d'être exemptée de la règle 90A du Règlement n° 0-8 de la Commission canadienne des transports, le Règlement unifié d'exploitation, C.R.C. de 1978, chap. 1175;

RELATIVE aux essais destinés à vérifier la fiabilité du moniteur de queue et des dispositifs connexes et à apprécier les risques que comporte l'exploitation de trains sans équipe de queue, conformément à la décision du 16 septembre 1985 du Comité des transports par chemin de fer concernant l'essai des trains sans fourgon de queue;

RELATIVE à l'ordonnance n° R-41300 en date du 14 décembre 1987.

N^{os} de référence: 4357R90-A.1
4357R90-A.2

ATTENDU que la preuve démontre que toutes les aiguilles à ressort sur les voies du CN et du CP sont équipées de signaux;

ATTENDU que le paragraphe 3 de la règle 104A du Règlement unifié d'exploitation, C.R.C. de 1978, chap. 1175, exige que les trains ou les locomotives doivent s'arrêter pour qu'on examine les aiguilles à ressort de la voie principale avant de les prendre en pointe, à moins qu'une indication de signal ne permette d'avancer et assure, de cette façon, la protection prévue au paragraphe 1.31 de l'ordonnance n° R-41300 du CTCF.

PAR CONSÉQUENT

Le Comité des transports par chemin de fer modifie par la présente l'ordonnance n° R-41300 du CTCF en date du 14 décembre 1987 par la suppression du paragraph 1.31.

Signée ce 14e jour de décembre 1987.

John O'Hara

John O'Hara
Secrétaire
Comité des transports par
chemin de fer

Canada

CANADIAN TRANSPORT COMMISSION
RAILWAY TRANSPORT COMMITTEE

A DECISION PERTAINING TO CABOOSELESS TRAIN OPERATIONS ON CANADIAN NATIONAL AND CANADIAN PACIFIC RAILWAYS

Commissioner J.F. Walter
Chairman

Commissioner R.J. Orange

December 14, 1987

Le texte de cette décision est disponible en français sur demande.
Prière de s'adresser à:

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ACKNOWLEDGEMENT

In a Public Hearing of this magnitude the Commissioners sitting as a Panel depend to a great extent on the ability of staff to ensure the smooth functioning of every aspect of the hearing.

The physical arrangements in Ottawa and at seven locations across Canada were efficiently managed by Dee Bois and Bruno Henri. Jim Turner and Ray Beckert provided comprehensive technical advice. Gary McLaughlin and Lynne Morin were outstanding in evaluating the evidence and bringing it together into a workable and readable form.

Patricia Hassard and Serge Pépin provided us with sound and practical legal counsel.

The staff of the Railway Transport Committee Regional Offices made themselves available to us as required as we travelled across the country.

This task could not have been performed without the able help of all those mentioned above and the Panel is most grateful to them for their contribution individually and collectively.

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LIST OF ABBREVIATIONS

AAR = Association of American Railroads
ABS = Automatic Block System
BCCC = British Columbia Caboose Committee
CLU = Communications Logic Unit
CN = Canadian National Railway Company
CP = Canadian Pacific Rail Limited
CRLA = Canadian Railway Labour Association
CTC = Centralized Traffic Control
DMD = Distance Measuring Device
DND = Department of National Defence
DSL = Dynamic Sciences Limited (Vancouver)
ETIS = End-of-Train Information System
FEC = Florida East Coast Railway
FRA = Federal Railroad Administration
HBDE = Hot Box and Dragging Equipment Detector
HVM = Highly Visible Marker
IDU = Input and Display Unit
MBS = Manual Block System
NRC = National Research Council
NRLC = National Railway Labor Conference
RDU = Receive and Display Unit
RTC = Railway Transport Committee
SBU = Sense and Brake Unit
SKCC = Saskatchewan Keep the Caboose Committee
STU = Sense and Transmit Unit
TOCS = Train Order Control System
TOP = Track Occupancy Permit
UCOR = Uniform Code of Operating Rules
UTU = United Transportation Union
WGTA = Western Grain Transportation Act

1.0 TERMS OF REFERENCE

IN THE MATTER OF *an application filed by Canadian Pacific Limited, for approval of amendments to Rules 19, 19A, 90A and 102 of the Canadian Transport Commission's Regulations No. 0-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175;*

IN THE MATTER OF *an application filed by the Canadian National Railway Company for relief from Rule 90A of the Canadian Transport Commission's Regulations No. 0-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175; and*

IN THE MATTER OF *tests conducted to evaluate the reliability of the end-of-train unit and associated devices and to evaluate the risks associated with train operation without rear of train personnel required by the Railway Transport Committee pursuant to its decision of September 16, 1985 which dealt with the matter of testing cabooseless trains.*

Hearing this Case were:

Chairman: J.F. Walter
Commissioner: R.J. Orange
Commissioner: J.G. Drainville

Commissioner J.G. Drainville who served as a Member of the Panel throughout the public hearing processes, left the Commission effective June 15, 1987 and consequently did not participate in the preparation of this Decision.

File Nos. 4357R90-A.1
4357R90-A.2

The Railway Transport Committee of the Canadian Transport Commission decided to hear evidence with respect to the aforementioned applications of CN and CP. It was made clear at the outset that a previous hearing related to those applications pertained only to the testing of cabooseless trains. More specifically, in the decision of September 16, 1985 the following was stated on page 13:

> *"Finally, we should like to emphasize that the late 1984 and early 1985 public hearings were constituted only to hear evidence on the preliminary issue of the safety implications of testing cabooseless operations."*[1]

The evidence that led to the September 16, 1985 decision is part of the public record and was not treated as evidence before the Panel in this case. This was a new hearing with a new Panel, not an extension of the previous hearing, and all parties were asked to govern themselves accordingly. The Panel advised the parties that it expected to hear the case through the production of witnesses and evidence and not through the introduction of transcripts from the previous hearing. Furthermore, the Panel decided that, at the opening of the hearing on October 6, 1986 the applicants, CN and CP, would put their cases into evidence first and then be followed by the intervenors.

The fact that the RTC heard and rendered a decision pertaining to the operation of cabooseless trains on the Quebec North Shore and Labrador Railway was in no way to be construed as a prejudgement of the risks associated with nation-wide operation of trains without cabooses and rear train personnel. All parties were made aware of this.

It was made clear that the major issue before the Panel was whether or not the granting of the subject applications, for purposes of operating freight trains without cabooses and rear train personnel, would result in train operations that are safe in respect of the well-being of railway employees and the public. The consideration of this issue was very complex as it involved the identification and assessment of the risks involved in the operation of freight trains without cabooses and rear train personnel. In order to deal with this matter in a quantitative fashion, it had been

previously decided that certain test programs should be carried out. In the September 16, 1985 decision it was stated, on page 40:

> *"...we are confident that prudent evaluation of the test data, under the tests we are about to propose, will provide a good indication of the actual risks involved in operating freight trains without cabooses."*[2]

The tests were subsequently implemented under programs, the developments of which involved the participation of the railways, the unions and the RTC. The results were made available to all parties. The parties were expected to provide the Panel with their respective "interpretation" of the test results in the general context of the determination of the risks arising from the proposal to operate trains without cabooses.

In this respect, the Panel directed that the above-mentioned determinations of risk would be addressed in the following areas and level of detail, but not necessarily restricted to the following, in a quantitative fashion where possible and in a qualitative fashion where quantitative analysis was not possible:

a) the estimated risks of failure, under the present and anticipated operating conditions, of each individual function of the End-of-Train Information System (ETIS) including the rear emergency brake application option;

b) the estimated seriousness of the consequences of failure, under present and anticipated operating conditions, of each individual function of the ETIS including the rear emergency brake application option;

c) the estimated changes in frequency and severity of derailments arising from the removal of the functions of the rear train personnel and the caboose, that would not be provided by the ETIS and

related options, in combination with other modifications that might be instituted as a result of such changes (if they were to occur);

d) the estimated changes in frequency and severity of collisions between and by trains arising from the removal of the functions of the rear train personnel and the caboose, that would not be provided by the ETIS and related options, in combination with other modifications that might be instituted as a result of such changes (if they were to occur);

e) the estimated changes in frequency and severity of dangerous goods releases, employee injuries, and injuries to the public as in c) and d) above;

f) given the above determinations, on a system-wide basis, the estimated quantitative or qualitative variation in the above-noted risks, according to such factors as region (urban/rural), night/day, train length, track type (mainline/branchline), track signalling, commodity types carried, terrain, etc.[3]

It was directed that if an interested party were to determine, in any respect, that the granting of the applications would result in an increase in risk of accident or otherwise would result in a reduction in safety associated with train operation, that party was expected to address the issue as to why such a risk was unacceptable or acceptable taking into account, but not necessarily restricted to, the economic benefits or disbenefits arising from the granting of the applications.

The railways and other parties were expected to evaluate the social and economic benefits or disbenefits that would arise from a granting of the applications with the direct and indirect recipients of the benefits or disbenefits being identified.

It was explained that the major issue was not necessarily a matter of total acceptance or rejection of the applications. It was possible that limited acceptance or rejection would be made. In this respect, it was expected that the interested parties would address matters pertaining to the possibility of granting or disallowing the applications under special circumstances concerning, for example, times, locations, operating conditions, etc. The Panel wished to assess the risks and benefits of practical alternatives to the simple acceptance or rejection of the applications and expected the interested parties to assist in this respect.

The above formed the terms of reference for the hearing and the evidence upon which this decision is based.

2.0 AN OVERALL PERSPECTIVE

2.1 Introduction

In the face of growing competition there is increasing pressure on management to innovate and to reduce costs. This often results in the introduction of new technology, aimed at improving productivity, but which often displaces or replaces workers and as a consequence may improve or reduce safety. In this respect, for the past few years, a controversy has surrounded the fate of the railway caboose.

The Canadian National Railway Company (CN) and Canadian Pacific Limited (CP) have questioned the continued need for the caboose on their freight trains. They have also argued that the railway employees who now occupy the caboose could be relocated to the head end of the train — not only maintaining the current level of safety, but also yielding a substantial reduction in operating expenses and enhancing the conductor's role as the employee who is in charge of the operation of the train.[1]

The railways' position is that because technological change has rendered the caboose obsolete the location of train crew at the rear of a train is unnecessary and uneconomic. They feel that the caboose can be removed and the rear train crew relocated to the locomotive cab without reducing safety. The railways point to the cabooseless operations in Europe and, more recently, in the United States where accident records are claimed to prove that safety has not been reduced by the transition to cabooseless operations. They argue that the need for reduced costs is essential for them to meet competition from United States carriers and the trucking industry and to assist in the maintenance of Canada's market share in world export trade.[2]

The latest technological innovation that has advanced the railways' plan to operate cabooseless trains is an electro-mechanical device, referred to as the ETIS. It performs some, but not all, of the functions which are now performed by the rear train personnel. As with any new piece of equipment to be used in mechanically and climatically harsh environments,

questions have arisen about the reliability and accuracy of the ETIS and the risks associated with its use.

The Canadian Railway Labour Association (CRLA), the United Transportation Union (UTU) — representing the train crew employees — several regional "Save the Caboose" committees and a large number of public interest groups and individuals counter that the caboose and the rear train personnel located in the caboose are essential ingredients for an acceptable level of railway safety in Canada. The core of their argument is the contention that the caboose and the presence of an employee at the end of the train affords the conduct of certain safety functions that cannot be carried out by the ETIS on a train without a caboose and with the rear crew located in the locomotive cab. They claim that the present level of safety would be reduced if the railways were permitted to operate cabooseless trains.[3]

The primary responsibility to ensure railway operations are safe rests with the railway companies.

The Railway Transport Committee (RTC) of the Canadian Transport Commission, among other duties, has a legal responsibility to promulgate rules and regulations pertaining to railway safety. One such set of regulations is the Uniform Code of Operating Rules (UCOR) which requires trainmen to be at the front and rear of trains in a position to observe the safe operation of trains. The UCOR also requires the train crew to perform other duties which the UTU claim would be more difficult or take longer to do if there are no employees at the rear of the train.[4] As a first step to permitting the operation of cabooseless trains, CP and CN have therefore applied to the RTC to have the UCOR amended or to be relieved of certain provisions of the UCOR.

Following its normal procedure in dealing with national safety-related issues, the RTC sought evidence pertaining to the caboose question from all corners of the country through the use of public hearings. This decision results from due consideration of all the facts and opinions

presented to the RTC verbally and in writing with respect to the railways' applications for change.

2.2 The History of the Caboose and its Occupants

The caboose first came into use in North America in the mid-1800's. The derivation of its name is normally attributed to words in a number of languages meaning "little room or hut". Indeed, some of the original purposes of the caboose were the provision of shelter, a place to store tools and supplies, and a location where the train conductor could do his paper-work.

One of the major reasons for locating an employee or employees at the rear of the train in the caboose, prior to the turn of the century in North America, was to facilitate train control through the use of mechanically operated hand brakes installed on each car. In pre-air brake days, the head end crew operated the steam locomotive and the locomotive brakes. When they could not adequately control train speed, the locomotive engineer would signal the rear crew, by whistle, to set hand brakes on the caboose and on nearby cars. In the event that the train broke in two as a result of this type of braking procedure, the rear crew would have to set more hand brakes on more cars to stop and secure the rear portion of the train. The adoption of the air brake system in North America in the early 1900's removed braking duties of the rear crew in respect of normal operational train control. This was because the automatic air brake system provided control of the brakes on all cars on the train from the locomotive cab. The air brake system was also designed to ensure that both portions of a train that broke apart would automatically stop. The rear crew has, however, retained the responsibility to apply the train brake in an emergency situation when the head end crew, due to air brake failure or other reasons, is unable to perform this function. Likewise, rear crews are required to operate the emergency brake from the rear of the train using their own judgement, in situations that call for the initiation of immediate braking without the delay of requesting a brake application from the head end.

The UTU claims that the present separate locations of the locomotive engineer and the conductor leads to "checks and balances" that enhance the safe operation of the train, and that this would be lost if the conductor were also at the front of the train.[5]

During the steam locomotive era, the caboose itself served a number of functions. The caboose served as a mobile supply depot for tools, parts and materials necessary to make light repairs to the train en route. The conductor had a significant amount of paperwork to do and the caboose was his office. In locations where flagging or signalling with lights were required to warn trains approaching from the rear, locating crew at the rear of the train minimized delay. An employee at the rear also facilitated realignment of hand thrown switches. Then, as now, the rear crew was responsible for observing the condition of passing trains and for communicating any problems — in the past by hand signals, but at present both by radio and hand signals. The rear crew was required to watch for wayside employees who may note something wrong with the passing train. The caboose was also used to haul express, company mail, freight, and in a few situations paying passengers, and employees "deadheaded" to and from jobs, and as living quarters for crew who were away from their home terminals.

According to the railways, the introduction of diesel locomotives resulted in many mechanical advantages as well as more spacious, clean and accommodating locomotive cabs, suitable for housing operating crew in safety and relative comfort. The amount and variety of parts, tools and materials to be carried in the caboose has decreased by virtue of improved ability and mobility of equipment repair forces, the reduced need for en route repair of cars, servicing of journal boxes and the rigging of wayside telephones. Computer information technology has significantly reduced the paperwork of the conductor. The introduction of stationary crew hostels has replaced the use of the caboose as away from home living quarters. Other technological developments such as Centralized Traffic Control (CTC), modern radio communications, and wayside hot box and dragging equipment detectors (HBDE), have reduced many of the traditional duties of the rear train crew, such as flagging, tending of oil lamps and realignment of switches but the rear crew

is still required to maintain a lookout for bearing failures, shifted loads, dragging equipment and other problems which may arise en route.[6]

The UTU argues that new technology can complement safety measures, but no mechanism can substitute completely for personal diligence. Furthermore, they believe that the presence of technology could promote human complacency. The UTU, however, "*...agrees that the efficiency of railway equipment and the use of modern technology certainly reduces the probability of railway accidents*".[7]

Various developments over the years have reduced the need for certain functions of the caboose and duties of the rear crew; however, other functions and requirements have also evolved. With the introduction of modern air brake systems, air gauges were installed in cabooses and the rear crew is required from time to time to inform the locomotive engineer of the brake pipe air pressure readings to assist the engineer in knowing the state of his air brake system. As well, the rear crew must verify the continuous functioning of the air brake system by observing the brakes at the rear of the train during air brake tests. The introduction of modern air brake systems also permitted a substantial increase in the length of trains. At present, it is not unusual for trains to contain in excess of 150 cars carrying up to 15,000 tons. The early lengthening of trains increased the need for observation from the rear since the ability of the front end crew to see the whole train diminished. The presence of rear crew minimizes the delay resulting from the need, from time to time, to walk the length of the train to carry out switching, inspection or repair duties. Increased dangerous goods traffic and public awareness of the hazards of chemical spills have increased the importance of the role of the conductor as a custodian of critical documents describing the contents of the cars, and as a guardian to restrict public access to the derailment site from the rear of the train.

Early development in the uses and functions of the caboose and the later evolution of those uses and functions caused the caboose to grow in size, to change in design and to have its amenities expanded. Today, the

caboose weighs about 28 tons. It usually contains a heater, a desk with chairs, clothes lockers, lamp, running water, flush toilets, electric hot plate, refrigerator, electric lights, two-way radios, a couch, first-aid kit, a stretcher and a cupola for look-out purposes.

Just as the physical attributes of the caboose have evolved, so have the functions of the train operating personnel. The railways argue that this evolution has rendered the caboose unnecessary and the location of the crew to the rear redundant with new technology.[8] The UTU, however, considers the history of the caboose to have no relevance to the railways' applications for change to the UCOR. The UTU also takes the position that the new technology should be used to supplement the traditional role of the conductor and the caboose.[9]

2.3 The Influence of Technological Development

Both CN and CP take the position that technological developments in the railway business have rendered the caboose obsolete and have resulted in a situation where the rear train crew no longer needs to be located at the rear of the train.[10] Some of these developments have been touched on briefly with respect to the history of the caboose.

Apart from the evidence pertaining to the ETIS which will be discussed in Chapter 3, and apart from the long past introduction of the air brake, the evidence on more recent technological developments most significant to the issue of cabooseless train operation will be reviewed herein.

Modern Train Control Systems

The two railways pointed out that, over the past 50 years, early automatic block signal (ABS) technology has evolved into a more sophisticated system known as Centralized Traffic Control (CTC).[11] CTC provides the means for failsafe control and protection of train movements in both directions on the same track. CTC also affords the dispatcher the ability to control

switch positions from a central location by means of electronic communications with power devices at switches. Where the switch is not powered, it is generally spring operated in a way that it restores itself to the normal position after a train has trailed through it.

At the present time, both CN and CP have trackage whereon train control is accomplished by Centralized Traffic Control (CTC), Automatic Block System (ABS), Manual Block System (MBS) or Train Order Control System (TOCS) as more specifically described in the following:

- **CENTRALIZED TRAFFIC CONTROL (CTC)** - A system in ABS territory under which train or engine movements are authorized by block signals whose indications supersede the superiority of trains for both opposing and following movements on the same track. The signals and switches within this system are controlled by a train dispatcher from a central location.

- **AUTOMATIC BLOCK SIGNAL SYSTEM (ABS)** - A series of consecutive blocks governed by block signals, cab signals, or both, actuated by a train or engine, or by certain conditions affecting the use of a block. Within this system, trains are operated by timetable and train order authority under the direction of a train dispatcher.

- **MANUAL BLOCK SYSTEM (MBS)** - A system in which the train dispatcher from a central location communicates by telephone or radio to trains and maintenance of way employees for issuance and verification of authorities or track occupancy permit (TOP). Here, protection is provided by restricting movements in the affected territory except in ABS territory where signal indications provide protection for following movements.

- TRAIN ORDER CONTROL SYSTEM (TOCS) - A system where the train dispatcher from a central location issues train orders and clearances either by telephone or radio to affected employees. Relief from rear flag protection may be provided by the train dispatcher issuing a Form U train order.

The significance of the development of modern train control systems to cabooseless train operations is two-fold, according to CN and CP. Both railways indicated that the need for manual rear end flagging to protect the rear of a train is no longer necessary on lines where train movement is controlled by CTC, ABS, MBS or where relief is provided from flag protection through the use of train order protection. As well, on trackage with remote dispatcher controlled power switches and/or spring switches they feel that the need for manual realignment by a crew member at the rear of the train is no longer necessary.[12]

Wayside Protection

All parties generally agreed at the hearing that prevention of derailments has been a main duty of train crews since railroading began. Two significant causes of derailments have been and remain car wheel bearing failure and dragging car equipment. The former manifests itself as heat and results in smoke and perhaps sparks or fire near the bearing, which can be observed from either end of the train as long as the sight distance permits and as long as there are no obstructions of the line of sight. The introduction of roller bearings made the observation of overheated bearings more difficult as the symptoms are less visible than with the old friction bearing. Moreover, the introduction of roller bearings increased the need for greater vigilance as, once a roller bearing begins to fail, it can go to destruction significantly faster than the old friction bearing. Apart from bearing failures, dragging equipment can manifest itself as steel on steel sparks. These may be visible from both ends of the train, and in some cases can be identified by marks on railway ties, crossing planks, ground or snow, that can be seen by the rear crew.

The railways, however, questioned the adequacy of the visual inspection of the train.[13] With longer trains the ability to see all cars from both ends of the train has decreased. Indeed, there are obviously periods of time when visibility is totally restricted. As a result, and more recently, (CN started in 1967) the introduction of electro-mechanical wayside detection devices has reduced the role of the rear end crew in the area of running inspections for failing bearings and dragging equipment, according to the railways.

On the other hand, the UTU maintains that the rear crew observe many hot boxes and dragging equipment occurrences. It claims the new technology is not consistent in performance, does not do all that a rear crew can do, and the removal of the rear crew therefore reduces the margin of safety. The UTU suggests that, as the capacity to make rational decisions based on sensory information is a human attribute, the best and safest system is a combination of humans and technology.[14]

Evidence at the hearing indicated that the hot box and dragging equipment detector (HBDE) is now common-place on all major and some secondary routes of both CN and CP.[15] The HBDE incorporates track-side scanners that sense heat radiating from the wheel bearings. The HBDE in one way or another (dependent on type and make of the HBDE) actuates an alert that results in the stopping of the train to be checked by train crew to verify that there is a failing bearing. If the HBDE detects dragging equipment, the train is also stopped and checked by the crew. The railways argue that this constant trackside checking adds to the reasons why train personnel need not be located at the rear of the train.

The railways admit that HBDE's are not located everywhere on their trackage, and CP testified that they are aiming at an average spacing in the 25 to 30 mile range[16] — a distance within which a bearing, particularly a roller bearing, could possibly fail and burn-off causing a derailment. CP admitted that roller bearings could overheat severely in approximately 10 miles[17] and could burn out in 10 to 15 miles.[18] The railways contend that only to the extent that the rear train personnel can see a bearing failure

could their presence at the rear of a train potentially add to the security against derailment of cars, to the rear of the train, due to bearing failure. As well, only to the extent that the rear crew check the track for marks, that such marks can be seen by the rear crew, and that the dragging equipment does not cause a derailment before the tell-tale marks are visibly seen, could the rear crew potentially reduce the chance of dragging equipment causing a derailment.[19]

As with any mechanical or electrical device subjected to the environment and hard use, HBDE's are not always reliable, as evidenced by CP's own written submission to the RTC on April 15, 1981 just following the Mississauga Accident Inquiry where CP said *"...unfortunately, hot box detector systems can and do fail in a manner such that overheated journals can be missed."*.[20] In that same submission, CP stated that HBDE are not the sole means of detecting failing bearings *"train crews are still required to make frequent running inspections."*.[21] The UTU points out that now the railways are attempting to remove the running inspection from the rear by relocating the rear crew to the front of the train.[22]

Modern Radio Communications

The evidence shows that the use of two-way radios to replace hand, whistle, and light signal communications commenced in the 1950's. The improvement in that technology has not only increased the quality, reliability, and range of transmissions but also reduced the size and weight of the portable units which are common-place on Canadian railways. Radios have enhanced safety, particularly in the area of dispatching trains and in emergencies. Unlike early train operations, the train crew can instantly communicate with each other, with wayside track forces, with crews of other trains, who may be inspecting the train as it passes, and with the dispatcher. The railways also argue that radio alerts to other trains in the vicinity are far quicker, and hence far safer, than the traditional use of signal flags.[23] Dispatchers do, however, still rely on line telephones for issuing orders.

The railways claim that the modern use of radios has reduced the need to have crew at the rear of the train, to observe hand signals from wayside track forces or from crews on passing trains.[24] Also, the need for crews to flag to the rear in emergencies, can also be reduced by modern radio usage.

The train to wayside radio coverage is not, however, available on all trackage. Direct radio communication with a dispatcher is not therefore always at hand. For example, CN explained that 15% of their trackage has no train to wayside coverage.[25] There are also times when the head end is without radio communication due to radio failure.[26] During these times, the radio communication from the rear of the train would be available. Furthermore, there are areas such as tunnels and other "blind spots" where radio communications are difficult or intermittent.[27]

The railways gave evidence that they expect the quality of existing radio communication systems employed by railways will continue to advance.[28]

Equipment Reliability

According to the railways, since they converted from steam to diesel-electric locomotives, there have been many improvements to the design of, and the materials used in, railway equipment.[29] This has not only reduced maintenance requirements but has also reduced the chance of derailment and the severity of an accident when derailment occurs.

They stated that perhaps one of the most significant developments relevant to this case is in the area of wheel bearings.[30] In the 1950's, almost all car axles had journals that rode on a solid brass plain babbitt bearing housed in a journal box integral to the truck frame (otherwise referred to as the friction or plain bearing). Wads of cotton waste were used within the journal box to ensure the application of lubricating oil to the journal. The cotton acted like a wick for the oil that was maintained at the proper level at frequent inspection. When lubrication failed, however, the bearing would overheat and disintegrate or melt, most often resulting in

a great deal of fire and smoke from the journal box. The heat would then cause the journal to "burn-off". Thus, a "hot box" situation leading to a "burn-off", would result in the collapse of the axle and truck of the car and provide the potential for a derailment.

During the 1960s, the cotton waste in the plain journal was replaced with a more efficient lubricator pad and, as a result, hot boxes were substantially reduced. However, according to CN the introduction of the lubricating pad reduced the amount of fire and smoke when the bearing did fail and thus observation of potentially failing bearings by the rear or front crew was reduced.[31]

The substitution of the plain bearing with roller bearings, which began in the early 1960's, resulted in an even greater reduction in the frequency of bearing failures, according to CP[32] and CN.[33] Roller bearings have greater quality of construction. Because they are sealed, the bearing lubricant is less vulnerable to contamination and internal friction is minimized. Today the North American car fleet is approximately 75% roller bearing equipped. The active revenue fleet of CN is about 65% roller bearing equipped which results in 85% of CN's on-line car mileage being roller bearing mileage. CP's fleet is planned to reach 75% roller bearing equipped in 1987 as is required by RTC order. Special inspection attention is given to trains and cars without roller bearing equipment.

The introduction of roller bearings, even though reducing the incidence of a bearing failure and reducing bearing maintenance requirements, has the potential to increase the chance of a failed bearing causing a derailment. This is because the roller bearing, once it begins to fail, does so faster than the plain bearing and it also does so without readily observable symptoms (fire, smoke and odour). The HBDE's are effective in detecting the heat of the distressed roller bearing. Whether or not the HBDE are sufficiently close to each other to detect all distressed roller bearings before burn-off occurs, is a matter that has been debated within the railway industry and that was questioned at the hearing. It is nevertheless clear that failing roller bearings are harder to see than failing plain bearings

and that there is less time to observe a failing roller bearing. The railways accelerated the use of hot box and dragging equipment detector technology to compensate in part for this fact.

The railways have pointed out that other significant improvements in freight car equipment have taken place. For example, the introduction of double shelf couplers, tank end protection shields and tank insulations have tended to reduce the chance of the release of dangerous goods leakage at a derailment. These changes have also resulted in post-accident hazards being reduced.

The UTU is of the opinion that technological innovations adopted by CN and CP have been for productivity gains and not purely for safety reasons. Nevertheless, the Union does not dispute that technological developments have improved safety on the railways as a "spin-off".[34] The UTU's view is that the present level of safety, given current technology, is acceptable and should not be reduced in any way. In this respect, the UTU also argues that granting the railways' applications would reduce railway safety to an unacceptably low level, irrespective of the railways' use of modern technologies.[35]

2.4 Cabooseless Operations Elsewhere

General

The railways' evidence indicated that the caboose largely became obsolete in Europe with the introduction and acceptance of the automatic air brake system on trains.[36] From the standpoint of en route switching of cars, European railways lent themselves to cabooseless operations mainly because of the relative proximity of manned stations and the length and weight of trains employed there. Fewer crew members were required than in North America, where manned stations were few and far between. Cabooses were eliminated in West Germany over 30 years ago,[37] according to CN, and the typical European train crew now consists only of an engineman and a guard (conductor). In

many cases in France and West Germany the crew consists only of an engineman[38] according to CP.

CN also gave the example where, in New South Wales, Australia, 26 unit coal trains per day operate cabooseless as do other trains in Queensland and Western Australia.[39]

In North America there are isolated instances of long term use of cabooseless freight trains. For example, according to CN, the Florida East Coast Railroad in the United States has operated totally cabooseless since 1975.[40] In Canada, CP reminded the Panel that the Quebec Cartier Railway between Port Cartier and Mount Wright, in Quebec, has operated its iron ore trains without cabooses since its inception in 1960.[41] CN presented evidence to show that, over the last seven years, both of these railways have had consistently lower train accidents per million train miles than CN.[42]

The Florida East Coast Railroad (FEC)

Following a strike in 1963, the FEC eliminated from their collective agreements all requirements for cabooses on its trains. Today the FEC operates 22 through freight trains per day, plus local and way freight services, over 367 miles of CTC controlled trackage with HBDE's[43] from Jacksonville to Miami without cabooses.[44] FEC branch lines are not signalled but rather operate under radio block rules (MBS) without flagging requirements[45] according to CP. The FEC freight crew consist of a locomotive engineer and a conductor who usually operate the full distance of 367 miles. Local trains operate with a locomotive engineer, conductor and trainman.[46] All crew ride in the locomotive cab.

The U.S. Federal Railroad Administration (FRA) requires a light to the rear of the train[47] and the FEC therefore has installed a battery powered light, of the required intensity, on the last car in lieu of the caboose.

CP explained that the FEC also operates with a 32 pound device on the rear car, referred to as the End of Train Detector. It transmits a radio

signal, every 60 seconds, to a receiver in the locomotive cab indicating that the rear brake pipe pressure is greater than 45 psi. It also warns of lack of radio transmission, emergency application of the brakes and out of range warnings if the train breaks apart and the end is left behind even where there is not an automatic emergency brake application due to a break apart.[48]

Recent United States Developments

Until recently, in the United States, most freight trains ran with a caboose because of collective bargaining restrictions on the operation of cabooseless trains. Management and labour confronted each other over the safety implications of operating without a caboose and the dispute continued without very much empirical data to support one side or the other.[49]

In this respect, a Presidential Emergency Board No. 195 was appointed, by Executive Order dated July 21, 1982, to investigate a particular dispute between the United Transportation Union and certain railways represented by the National Carriers Conference Committee of the National Railway Labor Conference. Part of the dispute pertained to the position of the railways that cabooses should be eliminated. The Board, in a report to the President dated August 20, 1982, page 17 said:

> *"...we conclude that, subject to the conditions and limitations hereinafter set forth, cabooses may be eliminated in each class of service without undermining safety and operational considerations. Moreover, we do not find any justification for excluding the elimination of cabooses in through freight service from arbitration procedures where disputes arise in specific cases.*
>
> *The Board believes that the elimination of cabooses would be an on-going national program. The program can be most effectively implemented by agreements negotiated on the local properties by the representatives of the Carriers and the Organization most intimately acquainted with the complexities of individual situations."*[50]

On October 15, 1982, the subject U.S. carriers and the U.S. UTU came to an agreement which adopted the essence of the paragraph noted above. The provisions of that agreement have so far resulted in over 2,300 cabooseless trains per day operating in the United States.

CN evidence indicated that the National Railway Labor Conference (NRLC) has determined that, as of June 1986, cabooseless operations as a percentage of total freight train-miles in the United States are:

Through Freight	26.2%
Local and Way Freight	31.4%
Total Freight	27.0%[51]

At present, according to CN, the Federal Railroad Administration (FRA) has no regulations specifically related to cabooseless operations.[52] It is the Panel's understanding, however, that the use of an ETIS to determine brake pipe continuity is approved by the FRA.

In order to fully understand the environment within which the current cabooseless operation exists in the United States, the conditions and limitations on cabooseless train operations which were contained in the aforesaid Emergency Board Ruling must be considered.

Those conditions and limitations are, in part, as follows:

"*Accordingly, the Board* (the Emergency Board) *recommends that the parties negotiate guidelines on the national level for local implementation, that will be directly responsive to, or deal with, the following matters:*

a. safety of employees

b. operating safety, including train length

c. effect on employee's duties and responsibilities resulting from working without a caboose

d. availability of safe, stationary, and comfortable seating arrangements for all employees on the engine consist

e. availability of adequate storage space in the engine consist for employees' gear and work equipment.

The Board recommends that each Carrier has the right to eliminate cabooses in all other-than-through freight service, subject to arbitration. The Board further recommends that each Carrier has the right to eliminate cabooses for not more than twenty-five (25%) percent of all through freight trains by the end of the agreement, subject to arbitration.

Notices for the elimination of cabooses should identify specific or similar assignments.

With regard to the elimination of cabooses in through freight service, the Board recommends that the Carrier shall not invoke final, binding arbitration provisions until the parties have resolved the caboose issue on all through freight trains regularly operating with 35 cars or less. Such cabooses so eliminated shall be counted toward the 25% maximum".[53]

CP testified that the U.S. Presidential Emergency Board Ruling requires that the need for flagging to the rear must be eliminated for cabooseless operation of through freight trains which are over 35 cars in length.[54]

It appears from these statements that the Presidential Emergency Board considered that the removal of the caboose could influence the safety of train operations and of the train crew. As well, the Board seemed to feel that the transition to cabooseless operations could influence the future job security of rear train personnel. Moreover, as evidenced by items (d) and (e), the Emergency Board appeared to be concerned that transition to cabooseless operations might result in undesirable working conditions for crew eventually located in the engine consist. The Presidential Emergency Board would, of course, be concerned primarily with job security and working conditions since its mandate stems from the U.S. Railway Labor Act unlike in this case where the mandate of the Panel stems from the safety provisions of the Railway Act.

The Impact of Cabooseless Operations on United States Railway Safety

In the Panel's opinion, the experience of cabooseless operation in the United States, in terms of its impact on railway safety, is much more

relevant than consideration of the experience in Europe. In the United States, there has been a recent swing to cabooseless operations from a situation where almost all trains were operating with cabooses. The similarity of American operating conditions to those in Canada, save for the influence of moderately different weather conditions, further supports the railways' opinion that comparison with the United States experience is more relevant than comparison with the European experience.

The impact of the trend to cabooseless operations in the United States has been measured and evaluated since the time that union-management agreements permitted the change. On this matter, Mr. Joseph W. Shuster, of the National Railway Labor Conference (NRLC) described the results of a research project entitled *"The Caboose as an Influence on the Safety of Train Operations in Through Freight Service in the United States — January 1984 through December 1985"*, dated October 3, 1986.

Mr. Shuster's study evaluated the impact of about 450 million cabooseless train-miles over a 2 year period. Proportionately, that equates to 8% of all through freight train-miles in the United States in 1984 and 19.2% of all through freight train-miles in 1985. Although the study did not consider local and way freight and yard switching operations, of the non-caboose train-miles in 1985, 79% of cabooseless train-miles were in through freight service.

The accident rates for caboose and non-caboose operations are seen in the following table. From this it was argued by Mr. Shuster that there is no statistically significant difference between the accident rates for caboose and non-caboose operations in the United States.[55] It also shows that the number of derailments and collisions are less for cabooseless trains while other accident rates are higher for cabooseless trains. Further, it shows that the cabooseless operations had fewer mechanical and track-related accidents and more operational and miscellaneous accidents.

Table 1

RAIL EQUIPMENT ACCIDENT RATE

(1984-1985)

(accidents per million train miles)

	Caboose	Non-Caboose	Total
1984	4.90	5.04	4.91
1985	3.81	3.86	3.82
Total	4.37	4.17	4.34
Derailments	3.48	3.12	3.43
Collisions	0.37	0.34	0.37
Other	0.52	0.71	0.54
Mechanical/Electrical	1.27	1.08	1.25
Track/Roadbed/Structure	1.45	1.02	1.40
Human Factors/Operations	0.92	1.21	0.96
Miscellaneous	0.73	0.85	0.74

Source: Exhibit CN-4, pages 4-6.

Apart from the analysis of accident rates, Mr. Shuster also evaluated the differences in the severity of accidents in terms of dollar damage on trains with and without cabooses. The results show that the accident severity rate was lower for cabooseless operations on average, and substantially so when derailments were involved, slightly higher for collisions and higher for other types of accidents. With respect to accidents by cause, the cabooseless operations severity rate was lower for all categories of cause, except miscellaneous causes.

Table 2

RAIL EQUIPMENT ACCIDENT SEVERITY
(1984-85)

(damages ($000) per million train-miles)

	Caboose	Non-Caboose	Total
1984	502.0	296.0	486.8
1985	372.9	341.1	366.8
Total	439.0	329.3	424.1
Derailments	375.5	246.4	358.0
Collisions	46.1	47.6	46.3
Other	17.3	35.3	19.8
Mechanical/Electrical	146.5	74.3	136.7
Track/Roadbed/Structure	149.6	74.2	139.4
Human Factors/Operations	87.7	74.7	85.9
Miscellaneous	55.2	106.2	62.1

Source: Exhibit CN-4, pages 7-9.

By dividing the cost of accidents per million train-miles by the frequency of accidents per million train-miles, Mr. Shuster's results can be translated into cost per accident figures which may also outline the significance of cabooseless train operations. The results are shown in the following table.

Table 3

RAIL EQUIPMENT ACCIDENT SEVERITY
(1984-85)

(damages ($000) per accident)

	Caboose	Non-Caboose	Total
1984	102.4	58.7	99.1
1985	97.9	88.4	96.0
Total	100.5	79.0	97.7
Derailments	107.9	79.0	104.4
Collisions	124.6	140.0	125.1
Other	33.3	49.7	36.7
Mechanical/Electrical	115.4	68.8	109.4
Track/Roadbed/Structure	103.2	72.7	99.6
Human Factors/Operations	95.3	61.7	89.5
Miscellaneous	75.6	124.9	83.9

Source: Previous two tables.

Mr. Shuster concluded that "*...the sudden and serious adverse consequences predicted by the proponents of the preservation of the caboose have simply not appeared in this examination of overall accident frequency and severity*".[56]

The NRLC study also examined employee casualty statistics for 1985 and demonstrated that casualties due to all causes and those due to moving equipment were significantly lower on cabooseless trains as seen in the next table.

Table 4

EMPLOYEE CASUALTY RATE
(1984-85)

(casualties per million train-miles)

	Caboose	Non-Caboose	Total
A. All Causes			
Lost Days	3.35	1.55	3.02
Restricted Days	1.64	1.31	1.58
Other	2.01	1.50	1.92
Total	7.00	4.36	6.52
B. Moving Equipment			
Lost Days	1.54	0.56	1.36
Restricted Days	0.82	0.29	0.72
Other	1.00	0.83	0.97
Total	3.35	1.68	3.05

Source: Exhibit CN-4, page 13.

Moreover, the analysis showed that the severity of the casualties in terms of days lost were significantly less for cabooseless operations.

Table 5

SEVERITY OF EMPLOYEE CASUALTIES

(days lost per million train-miles)

	Caboose	Non-Caboose	Total
A. All Causes	90.5	48.4	82.9
B. Moving Equipment	43.2	14.9	38.0

Source: Exhibit CN-4, page 14.

Mr. Shuster concluded from this that the frequency and severity of employee injuries were significantly lower in cabooseless operations.[57]

Mr. Shuster summarized his testimony as follows:

> *"In summary, the removal of the caboose in the operations studied shows no indication of an increase in rail equipment accident frequency or severity and a beneficial effect on employee safety."*[58]

Applicability of the United States Experience

The UTU argues that the experience in the United States with the transition to partial cabooseless operations is not directly relevant to the deliberations over the applications of CN and CP, since *"The cultural, political attitude and legislative procedures, in the United States, are completely dissimilar to Canada notwithstanding the geographical proximity of the two countries"*.[59] The Union stated that the UTU in Canada has complete authority and autonomy from its U.S. counterpart. The UTU in Canada has always opposed the operation of cabooseless freight trains on the grounds of safety. The major difference, according to the UTU, is that in Canada legislation *"...requires a regulatory body to decide whether or not the safety of the public is placed in jeopardy by the operation of cabooseless trains"*. The matter in the United States was resolved by labour agreement.

In this respect, the Canadian UTU acknowledges that the American UTU entered into agreements with railway companies which permit the limited operation of cabooseless freight trains.[60]

2.5 Economic Considerations

Transport Competition

Both CN and CP explained that their respective companies are having difficulty meeting United States rail transportation competition, and that this has widespread ramifications because the United States is Canada's major competitor in the global marketplace.[61] Their contention is that the difficulty of CN and CP meeting United States rail competition is reducing Canada's ability to compete in the North American export market to the world. It was more specifically explained by CN that the Staggers Rail Act of 1980 has resulted in United States routings being more attractive for international traffic, thus reducing the long-haul traffic revenues of Canadian railways.[62] CP argued that this is mainly due to the economies of scale derived from consolidation and rationalization of United States railways, such as the combining of the Norfolk and Western and Southern Railroads into the Norfolk Southern System, the joining of the Chessie and Family Lines into the CSX Corporation and the Union Pacific-Missouri Pacific merger. According to CP, these new systems, referred to as "mega-railroads", not only have the capability of offering exclusive single line service, but can also make attractive interline business deals, all of which could alter traditional gateways and stiffen Canada/United States competition.[63]

CN also argued that technological change in the trucking industry and proposed new federal transportation legislation *"...point to increased pressure on railways to improve productivity in order to compete successfully in the truck-competitive market, both domestically and internationally"*.[64]

Commodity Market Competition

CP argues that in order for Canadian bulk resources to compete on the world market it must reduce its costs so that resource costs are less than those of countries with shorter transportation distances and lower costs, even though Canadian railways' charges are among the lowest of the developed western countries.[65]

The UTU suggests, however, that the relative competitive position of the railways should not be considered. Rather, the decision should be based on the merits of the railways' allegation that the level of safety would not be diminished if their applications are granted.[66]

Railway Profitability

It is CN's opinion that the introduction of cabooseless operations on United States railroads has improved their financial performance above and beyond the improvements resulting from the changed United States regulatory regime that began in 1980. The net result has been a decline in "real freight rates".[67] Furthermore, with respect to the influence of regulation, CN cited the new national transportation legislation as the potential cause of increased competition between and among modes of transport which should be offset by granting the railways a greater ability to reduce costs. In comparison with the United States situation, CN states *"To the extent that regulatory constraints were applied unevenly to the different modes, uneconomical distortions in the allocation of resources would result"*. CN further notes *"It is therefore important that Canadian transportation companies be permitted to make any and all innovations, such as cabooseless trains, which will contribute to keeping transportation costs to the lowest level". "...Access to technological implementation, equal to that of it's competitors, must be permitted"*.[68]

CN points out that there is an increasingly severe squeeze on profit margins. This results in a downward pressure on retained earnings from which investment expenditures are financed. Furthermore, CN claims that

such reduced investment can lead to a decline in service levels, productivity and, in the long term, the financial viability of the railway.[69] In this latter respect CN argues that, although financial performance has improved "significantly" since the mid-1970's, with profits being generated in each year except 1982, it feels its net income is not adequate for long term viability.[70]

CP testified that the major railways in North America find themselves in a precarious, if not critical, revenue position. In CP's opinion, the railways cannot significantly increase the rates they charge because of the ever increasing competition both from other carriers domestically, and from other worldwide suppliers in the export markets. Since the railways are, at the same time, experiencing a declining rate of growth, CP states that "*... they must look to any and all sources of cost reductions that will not jeopardize the service levels required by their customers.*".[71]

Applicability of Economic Considerations

The UTU argues that it is the primary responsibility of the RTC to ensure the protection, safety, accommodation and comfort of the public and of the employees of the railways. According to the UTU "*the economics of the railways is, if anything, a secondary responsibility ..... when the sole issue to be decided is the level of safety the public and the railway employees will be subjected to by the railway operations*".[72]

In this respect, the UTU accepts that the regulatory body should not impose restrictions, under the guise of safety, that would place an unreasonable economic burden on the railways, but they also feel that the acceptable level of safety should not be reduced simply to place the railways in a better competitive position with other modes of transport in Canada or North America.[73] In the Panel's opinion, it logically follows that neither should the level of safety be reduced to increase profits.

2.6 Costs and Cost Savings

General

Both railways, in response to directions from the Panel, described the costs of using cabooses and the cost savings of operating cabooseless. The Panel recognized that any economic analysis of essentially an unprecedented change must involve a series of assumptions and therefore must be treated with care in so far as the perceived accuracy of the results is concerned. In this respect, each railway conducted economic analyses that were not directly comparable. Nevertheless, from the evidence available it was possible for the Panel to make an order of magnitude determination.

Very simply, the costs of operating freight trains with a caboose involve the costs of ownership of the caboose, or capital costs, plus all direct and indirect costs incurred in moving, switching, maintaining and servicing the caboose and any other costs that can be fairly allocated to the existence of the caboose on the rear of freight trains. The cost savings arising from switching to a cabooseless operation depend on the proportion of the allocated caboose costs that can in fact be avoided, less the new costs associated with the operation of a cabooseless train. The savings would also depend on the proportion of trains that are converted to cabooseless operation and the rate of that conversion.

The costs of ownership, operation and maintenance of the ETIS plus any other costs (such as those due to delays) would reduce the avoided costs associated with caboose removal, the product of which results in the net savings that would accrue to the railways if they are permitted to operate cabooseless trains.

The Caboose Fleet

The railways' caboose fleet consists of roughly 1,400 units (820 for CN and 580 for CP) operating roughly 61.2 million caboose-miles per year (32.9 for CN and 28.3 for CP).[74]

Expense of Conventional Operations

CP and CN presented estimates of annual expenses that could be allocated to the operation of a caboose. A summary account of these estimates follows.

While the following table indicates the significant difference in cost estimates and perhaps actual costs of CN versus CP, the main thrust of this case pertains to safety and not to economics; there is therefore little need to be exact in considering such differences.

ETIS Capital Cost

If the railways could and would operate 100% cabooseless and the transition to cabooseless trains would be instantaneous, a major capital investment would have to be made in ETIS equipment. The evidence shows that the potential ETIS investment is $21.3 million for CN and $15.0 million for CP (for details see Appendix 2).

ETIS Operating Expense

Both CN and CP estimated the operating expenses for a 100% cabooseless situation as associated with the ETIS to potentially be $8.5 million per year for CP and $8.0 million for CN. A detailed account of those estimates is in Appendix 2.

Table 6

EXPENSE ALLOCATION TO CABOOSES

Expense Items	Total $	$ per Caboose*
CP Estimates:		
-Central Maintenance /Repairs	20,853,710	35,955
-Fuel and Roadway Maintenance	3,132,619	5,401
-Other Train Expenses	3,330,958	5,743
-Switching	11,480,964	19,795
Total Operating Expense	38,798,251	66,893
-Caboose Ownership Costs**	19,806,465	34,446
-Maximum Cost	58,604,716	101,921
CN Estimates:		
-Central Maintenance /Repairs	21,023,930	25,639
-Fuel and Roadway Maintenance	3,888,619	4,742
-Other Costs	1,620,435	1,976
-Switching	9,046,535	11,032
-Total Operating Cost	35,579,519	43,390
-Caboose Ownership Costs***	10,716,000	13,068
-Maximum Cost	46,295,519	56,458

*Based on 820 cabooses CN, 580 cabooses CP except for ownership costs which are based on 575 cabooses.

**Based on 19.6% RTC approved cost of capital x $175,000 CP purchase price estimate x 575 new cabooses with a 9% salvage value after 30 years (Exhibit CP-18, Page 14).

***Should be based on 10.45% real (inflation free) cost of capital x $118,714 CN purchase price estimate x 820 new cabooses = $10,172,602 (Exhibit CN-16, Page 21).

Sources: Exhibit CP-18, Pages 14, 24, 25, 27, 29, 31. Exhibit CN-37, Table A, Exhibit CN-16, Page 21.

Cost Comparisons

The foregoing provided a range of the costs of ownership and operation of cabooses and of ETIS. The range of operating and ownership costs per caboose removed can be calculated as follows:

Table 7

ALLOCATED OPERATING AND OWNERSHIP COST RANGES
($/Caboose)

Cost Category	High	Low
1. Caboose Operations	66,893	43,390
2. ETIS Operations	11,522	2,130
3. Net Operations (1 - 2)	55,371	41,260
4. Caboose Ownership	34,446	13,068
5. ETIS Ownership	7,571	3,287
6. Net Ownership (4 - 5)	26,875	9,781
7. ETIS Investment	25,976	26,087
8. Caboose Salvage	4,507	4,507
9. Net Investment (7 - 8)**	21,469	21,580
10. Before Tax Savings (3 + 6)	82,246	51,041
11. After Tax Savings*	41,123	25,521
12. Maximum Economic Before Tax Savings (10 - 6)	55,371	41,260

Source: Exhibit CN-18.

*Marginal tax rate assumed to be 50% even though only applicable to CP and not applicable to CN.

**Assumed to apply as cash flow in first year and does not include variable overhead or apparently replacement costs.

Irrespective of the large variations between the operating and ownership cost estimates in the above, it is clear that the net operational savings (after tax savings) in the first year would cover the net investment

in the ETIS. Because of this, it could be argued that there would no longer be an ownership cost after the first year. The savings in the first year would pay-out the investment. Moreover, it is reasonable to argue that the theoretical ownership costs in cabooses do not really involve a cash flow and therefore the abolition of the caboose would not result in a cash flow saving except for the salvage value that may be obtained. What is left then is a reasonable estimate of savings in the order of $41,000 to $55,500 per year per caboose removed before tax (see Table 7) which arises from a net ETIS investment of about $21,500 to $22,000 per caboose removed (see Table 7). Based on a current caboose fleet of 575 for CP and 820 for CN and assuming these savings and investment figures apply equally, the following table is considered to be a reasonable estimate of the economics of switching to cabooseless operations.

Table 8

ESTIMATED INVESTMENT AND SAVINGS ACCORDING TO THE PERCENTAGE OF CABOOSES REMOVED

Percentage Cabooseless	Investment* ($000,000)	Maximum** Before Tax Savings/Year ($000,000)
0%	0	0
10%	3.0	5.8 - 7.7
25%	7.5 - 7.6	14.4 - 19.3
50%	15.0 - 15.1	28.8 - 38.6
100%	29.9 - 30.1	57.6 - 77.2

*ETIS Investment.

**Assumes that all allocated costs are in fact avoidable.

Source: Table 7 applied against a total of 1,395 cabooses.

Given all of the above there can be little doubt that conversion to cabooseless operations, if safe, is perhaps one of the better investments CN or CP could make with potential annual before tax savings to both of up to

$77 million per year after the first year arising from an investment of up to $30 million. This differs from the calculations of CN and CP which amounted to an annual before tax savings of $34 to $50 million for CP[75] and $38 million for CN[76] for a total annual before tax savings of $72 to $88 million.

It is important here to accept that, if cabooseless operation proves to be safe, the railways are entitled to the resultant savings. Furthermore, if safe, the actual cabooseless operation savings are theoretically available to improve safety.

2.7 Related Rules and Regulations

The Existing Rules

At present, unlike those in the United States, Canadian railways are restricted from operating freight trains without a caboose by certain provisions of the Uniform Code of Operating Rules (UCOR). The UCOR is a regulation (Regulations No. O-8 of the Canadian Transport Commission C.R.C. 1978, c. 1175) and is applicable to all railways subject to the jurisdiction of the Canadian Transport Commission.

The UCOR is issued by virtue of the provisions in subsection 227(1)(*l*) of the Railway Act. In the words of subsection 227(1)(*l*) the purpose is to ensure safety to the public and to the employees — in other words, to minimize the risks associated with train operations. Any exemption or relief from this regulation or any modification thereto must be reviewed by the Railway Transport Committee and approved by the Canadian Transport Commission to ensure there is no net decrease in safety.

General Rule B of the UCOR grants the railways the authority to issue special instructions relating to the UCOR and these instructions are approved by the RTC.

CP has requested that certain amendments be made to Rules 19, 19A, 90A and 102 of the UCOR. CN has requested relief from Rule 90A. In addition, CP has given notice that it intends to modify rules 26A, 29A, 29B, and 29C of its CP RAIL FORM 582 which deal with air brake testing. Each of these potential changes raise issues which must be thoroughly considered before a final decision can be rendered.

RULE 90A

RULE 90A states the following:

> *"Unless otherwise directed by special instructions, on freight, mixed and work trains in motion between stations, conductors and enginemen will see that trainmen are at the front and rear of trains in position to observe the safe operation of trains and, when practicable, exchange signals when approaching and passing stations. Approaching junctions, railway crossings at grade, drawbridges, points where trains may be required to stop, where trains are to be met or passed, and at a safe distance before descending heavy grades or at any point where failure of the brakes may be attended with hazard, a trainman must be within convenient access of the emergency valve."*[77]

CN wishes to be relieved of having to comply with the above Rule[78] and CP has asked to have it changed to read:

> *"When freight, mixed and work trains in motion between stations are equipped with a caboose at the rear of the train, unless otherwise directed by special instructions conductors and enginemen will see that trainmen are at the front and rear of trains in position to observe the safe operation of trains and when practicable, exchange signals when approaching and passing stations."*[79]

The wording of this Rule proposed by CP is such that a caboose would be optional. When cabooses are provided, conductors and enginemen would see that trainmen are at the front and rear of the train in a position to observe the safe operation unless special instructions dictate otherwise.

The UTU, however, submitted a list of twenty-four safety related functions that they state the conductor performs due to longstanding practice and instruction. These functions, the Union contends, are performed while the train moves across the railway system between stations, and relate to the immediate on-going safety of freight train employees and the general public. They are as follows:

"1. *The safe and efficient operation of the train in accordance with the UCOR.*

2. *A vital backup to the front crew. The conductor is not engaged in the front operations of the train and all the distractions that go with controlling the train speed, etc., entails.*

3. *Ensuring the front crew complies with all the rules and regulations.*

4. *For the accuracy of train orders, registering the train, checking the accuracy of watches with crew members, reading safety bulletins and/or circulars, and ensuring the crew is knowlegeable of the contents. Also ensuring the radio equipment is operative.*

5. *The proper testing of air brakes and the mechanical inspection of the train where his crew members perform these functions.*

6. *Checking for the inclusion and accuracy of waybills, HIER forms, train journal or consist reports, length of train and tonnage.*

7. *Arranging the performance of duties enroute with crew members (i.e.: switching operations, lifting or setting off cars).*

8. *Train inspection prior to or when departing a terminal to ensure the train is properly marshalled and dangerous or special dangerous commodities are properly identified.*

9. *The protection of public crossings when making a reverse movement.*

10. *Ensuring that public crossings are not blocked and when blocked, arranging the clearance of crossings or the separation of the train in accordance with the rules to permit passage of vehicles.*

11. *Ensure that switching enroute is performed correctly, cars are properly secured when set off. When cars are picked up enroute, ensure they are properly placarded, identified, and marshalled to the proper location in the train.*

12. *Performance of brake tests and car inspections enroute.*

13. *Ensuring the rear of the train is properly identified (i.e.: markers displayed) and protected enroute.*

14. *Advising the train dispatcher and other personnel when the train has passed certain locations or restricted points to permit the efficient movement of following traffic.*

15. *The continuous observation of train handling, speed, track enroute, for example broken rails, fires on the right-of-way, inspection of public crossings as the train passes and speed of trains at restricted points. The continuous observation of both sides of the train to detect equipment failures such as sticking brakes, hot boxes and protruding loads. Detection of failures by using the human senses, such as sight, hearing, smell. When detected, the repair of these failures.*

16. *Confirmation with the front crew as to signal indications and ensuring these indications are complied with.*

17. *Confirmation of restricting orders and when meeting other trains, and ensuring the instructions are complied with.*

18. *Monitoring air pressure levels at the rear of the train and communicating this advice to the front crew.*

19. *Preventing an uncontrolled reverse of the rear of the train, when meeting other trains or when stopped just clear of a public crossing for example.*

20. *Advise the locomotive engineer as to the movement of the rear portion of his train when starting up or when stopping to enable more efficient train handling, prevent blocking public crossings and other points required to clear.*

21. *Inspection of passing trains. The conductor or rear employee is in the best position to inspect the undercarriage of a passing train from a lower vantage point than that of the front crew.*

22. *Return switches to normal position after the rear of the train has passed, for example when entering or leaving sidings.*

23. *Record the events of the trip and report same to the supervisors.*

24. *Providing emergency assistance to public crossing accident victims. The rear of the train is often at a closer location than the front crew by the time a train has stopped. In addition should a car strike the train behind the locomotive, often unknown to the front crew, the conductor monitors crossings to ensure accidents have not occurred."*[80]

The UTU argues that for the Applicants' case to succeed, all of the necessary existing functions of the rear end trainman, in a caboose at the end of the freight train, pursuant to Rule 90A, must be performed at the same level of safety to the public, at all times under all circumstances, when a freight train is moving between stations with only the protection provided by the new technology, (i.e. signalling systems, radio communication, hot box detectors and dragging equipment detectors).[81]

One duty of the rear end trainman that the UTU emphasizes is the immediate summoning of help and providing information and assistance to the police and emergency response forces at the site of an accident, particularly when dangerous commodities are involved. They argue that there are many highly probable situations when a collision or a derailment takes place wherein the head end crew is killed, incapacitated or has no access to the derailed cars, or the rear of the train, as a result of the wreckage caused by the accident.[82]

Another duty of the rear end trainman is the operation of the train brakes, in an emergency situation, when the head end crew is unable to perform this function, or is unaware of any need for stopping the train. As well, the rear end trainman is responsible for operating the emergency brake system, using his own judgement, and when the head end crew fails to respond to radio instructions. Both these duties, the Union contends, can only be performed by a trainman located at the rear of the freight train. Even an ETIS operation providing the facility to operate the rear end train brakes from the head end of the train would have been of no value in the Hinton accident, the Union points out.[83]

The UTU believes that with the conductor located at the head end of the train with the locomotive engineer and the head end trainman, there will be a social distraction effect, and the back-up or watchdog function now performed by the conductor at the rear will be lost, resulting in a less safe operation.[84]

Consideration of the respective positions of the railways and the unions raises a number of questions which will be considered later herein; namely:

1. Does the removal of the employee from the rear of a freight train who can observe the rear portion of the train and track to the rear reduce the present level of safety?;

2. Does the removal of the employee from the rear of a freight train who can make an emergency brake application from the rear of the train reduce the present level of safety?; and

3. If answered in the positive, are there equal alternatives to 1. and 2. such that the level of safety is not reduced?

RULE 19

CP has requested that Rule 19 be reworded. The existing and proposed versions follow:

Existing 19: ***MARKERS*** — *The following signals will be displayed to the rear of every train to indicate the rear of the train:*

(1) By day, markers not lighted.
(2) By night:

On single track and when running with the current of traffic on two tracks, markers lighted displaying red to the rear.

On two tracks, when standing or running against the current of traffic, markers lighted displaying red to the rear on the outside and green to the rear between tracks.

On more than two tracks, when running with the current of traffic, or when standing or running against the current of traffic, markers lighted displaying red to the rear unless otherwise directed by special instructions.

When a train is clear of the main track to be passed by another train, lighted markers will display green to the rear.

When the rear of a train is equipped with built-in markers they must be lighted by day and by night.

When a train is equipped to display a single flashing type marker it will be unlighted by day; by night it will display flashing red to the rear, except when clear of the main track to be passed by another train it will display flashing green to the rear.

EXCEPTION: *The requirement that markers display green to the rear when clear of main track does not apply in CTC."* (Centralized Traffic Control).[85]

CP Proposed Rule 19: *"Two markers will display red to the rear of every train by day and by night to mark the rear of the train. Electric marker lights must be lighted at all times. (Reflectorized marker plaques, displaying green to the front and red to the rear, may be used in lieu of marker lights).*

> ***EXCEPTION:*** *A train equipped with a single flashing or oscillating type marker will display red to the rear at all times."*[86]

The main question raised here is whether or not a reflectorized marker is as safe as an electric marker light in terms of identifying the rear of the train? This will be dealt with in the context of Rule 19A.

RULE 19A

CP requested a rewording of Rule 19A. The existing and proposed Rule 19A follow:

> Existing Rule 19A: *"A train not equipped to display markers as prescribed by Rule 19 will display a red flag by day and a red light by night to indicate the rear. The red light will be replaced by a white light when train is clear of main track.*
>
> ***EXCEPTION:*** *The red light will not be replaced by a white light in CTC."*[87]
>
> CP Proposed Rule 19A: *"A train not equipped to display markers as prescribed by Rule 19 will display a red flag by day or a red light by night to mark the rear of the train.*
>
> *NOTE: A reflectorized plaque may be used in lieu of a red flag or light."*[88]

Once again, the question is raised as to whether a reflectorized plaque is as safe as an electric marker light in respect of identifying the location of the rear of the train is raised.

A reflectorized marker requires a light source. A light is more positive and effective where a train is meeting another train in inclement weather and where a train is overtaking another train — particularly where track curvature is involved. A reflectorized plaque may not "pick up" the head light of a following train where severe curvature is involved. Lighted markers are important in MBS and non-signalled train order territory so that,

at meeting points, trains may be sure that the other train is complete and a portion of the train has not been left behind. In ABS and CTC territories this is not a consideration.

Lighted electric markers could be important in situations where trains close-up behind other trains.

RULE 102

Rule 102 is essentially to ensure the safe passage of trains overtaking and passing stationary trains or trains moving in the same direction on adjacent tracks. It states:

> *"When a train is disabled, or stopped suddenly by an emergency application of the air brakes or other causes, a lighted red fusee must immediately be displayed on adjacent tracks at front and rear of train. Adjacent tracks as well as tracks of other railways that are liable to be obstructed must at once be protected in both directions as prescribed by Rule 99 for* ***Outside ABS Territory*** *until it is known such tracks are safe and clear for the movement of trains."*[89]

CP has requested this Rule be changed to read:

> *"When a movement is stopped suddenly by an undesired emergency brake application or other abnormal condition, adjacent tracks, upon which Rule 105 does not apply, as well as tracks of other railways, that are liable to be obstructed, must, unless otherwise provided, be protected as follows:*
>
> - *by Rule 99 for Outside ABS Territory in both directions.*
> - *a radio broadcast three times on the end-to-end radio frequency in the form "Emergency Emergency Emergency Train ..... mileage ....., ... Subdivision."*
> - *after making this emergency radio transmission the train dispatcher will be advised by point to train radio of the train's identity, and the location of the undesired emergency stop. The train dispatcher will*

> *then advise all trains on the adjacent tracks not to pass the location of the undesired emergency stop until further advised. The train dispatcher will also advise the dispatching office controlling adjacent tracks of another railway of the undesired emergency stop.*
>
> - *Crew members will continue to provide Rule 99 flag protection on adjacent tracks until it is known that such tracks are safe and clear for the movement of trains or until relieved of the duty by the train dispatcher."*[90]

The proposed changes are substantial. The conditions under which this Rule applies would be altered by CP's request, and the means of alerting other trains would be changed. These changes are seemingly as a result of the inability of a cabooseless train crew to "immediately" display a lighted red fusee to the rear of the train or "at once" protect the rear as described in Rule 99. The issue is one of devising an alternative method of "immediately" notifying trains in the vicinity of the possible obstruction of adjacent tracks by a train stopped by an emergency application of the brakes or other causes. This will be discussed in detail later.

CN intends to *"...comply with UCOR 102 through the application of an operating instruction which prohibits the overtake of a cabooseless train in motion"*.[91] CN also intends to investigate *"... technical solutions to provide protection for trains operating on adjacent tracks as required by UCOR 102. When technical alternatives are developed, modifications to UCOR 102, as written, will be submitted to the Railway Transport Committee for approval"*.[92]

CN stated it has already recognized that the protection of adjacent tracks, as outlined in Rule 102, cannot always be provided now in a manner *"... timely enough to ensure full protection..."* and therefore emergency radio call procedures have been developed. CN Form 696 Section 3.4 prescribes a procedure similar to that proposed by CP which was noted above:

> *"When a movement is stopping as the result of an emergency application of the brakes, and other movements may be affected, the engineman or other employee must*

> *initiate an "EMERGENCY" call, giving identification and location, stating that the movement is stopping in emergency. Other movements must STOP and may proceed, prepared to stop short of an obstruction until the route is known to be safe and clear."*[93]

CN notes that with a caboose less train the protection of opposing trains on adjacent tracks will remain as it is now. CN proposes to void the need to protect immediately to the rear by precluding the operation of trains in the same direction on adjacent tracks to one on which a caboose less train is operating. In this respect, the following special instruction is proposed by CN:

> *"In the application of this rule (102), the train dispatcher will provide protection against movements to prevent a moving freight train operating without a caboose, from being passed by another train".*[94]

This would be accomplished in CTC territory by controlling block signals. In other territories protection would be provided by ensuring that neither a caboose less train nor any other train is operated against the current of traffic at a location that entails passing a caboose less train while in motion on an adjacent track. CN would intend that caboose less trains are provided with "positive rear-end protection" which means that following trains would not be given operating authority on an adjacent track until it is known that the stopped train is not fouling the adjacent track.

As to protection of following trains on adjacent tracks owned by other railways, CN only states that *"...arrangements will be made ... to ensure that protection for the rear of the train will be provided..."*.[95]

In final argument, CN stated that *"...arrangements will be made with other railways to secure the level of protection necessary to ensure safety. CP Rail is prepared to co-operate with CN in fulfilling this requirement, to the satisfaction of the RTC."*[96].

Other Uniform Code of Operating Rules

Introduction

In consideration of the possible introduction of caboose less freight train operations on CN and CP railways, a review of UCOR Rules, other than those associated directly with the railway applications, was made. This was to determine how those other UCOR Rules would be complied with in a caboose less operation.

Rule 14

Rule 14 concerns engine whistle signals to communicate requirements that must be complied with by certain railway employees. Some of the whistle signals are used to communicate from the front of the train to the rear. With modern radio communications some of the whistle signals listed in Rule 14, which are intended for the rear end crew, are redundant and in most cases have not been used in practice since the introduction of radio even though they are still required by the UCOR.

The removal of the caboose negates the need for the locomotive engineer to advise the conductor or rear trainman by whistle signals because the conductor will be in the locomotive cab.

Rules 17, 43(c), 98, and 113

Rule 17 concerns the displaying of the headlight and in part reads, "*...It must be extinguished when a train turns out to meet another and has stopped clear of the main track,...*".[97] Rule 43(c) states that trains must reduce speed to comply with the requirements of a train order that has been issued and the train must not increase speed until the entire train has passed the restricted point. Rule 98 requires trains to limit speeds at the end of two or more tracks, junctions, interlocked railway crossings at grade, and drawbridges until the entire movement has passed that particular point.

Rule 113 specifies a speed not exceeding 15 mph through turnouts whenever a certain siding or crossover is used, unless otherwise provided.

The concern with these Rules, if operating cabooseless freight trains, is how the head end crew would know when the rear car of the train is clear of the main track, the slow order, or the particular point referred to in Rule 98 or Rule 113.

The railways intend to use a distance measuring device (DMD) to ensure that the locomotive engineer has information concerning the location of the rear car of the train. CN listed a variety of situations under which they plan to use the distance measuring device of Digitair II.[98] CP intends to use similar equipment separate and apart from the Digitair II units.[99] The accuracy of this device was, however, questioned by the UTU — a matter that will be discussed later.

Presuming the DMD is sufficiently accurate, the above rules could be adhered to under a cabooseless situation.

Rule 34

Rule 34 states:

> *"Crews on engines and snow plow foremen must know the indication of fixed signals (including switches where practicable) and members of train crews must know the indication of train order signals affecting their train before passing them. All members of engine and train crews must, when practicable, communicate to each other by its name the indication of each signal affecting the movement of their train or engine."*[100]

There would be no problem in complying with this Rule in a cabooseless train operation. Crew (all members) would still be in a position to observe signals before they pass them, which is the intent of the Rule. Conductors located in the locomotive cab would, in all cases, know the signal indication and be able to take responsible action if the locomotive engineer fails to act appropriately.

The UTU alleged that crew members at the rear of the train traditionally observe signals after the locomotive has passed and this practice affords the opportunity to observe "false-clear" signals should they occur.[101] In view of the infinitesimal number of times this might occur as opposed to the advantage of having the conductor at the head end of the train to observe the signal aspect which governs the movement of his train, it is felt that the option of having the conductor in the locomotive cab far outweighs any safety enhancement that may result from discovering signal malfunctions.

In addition to this, professionally trained signal maintenance employees regularly carry out signal system tests to discover and correct malfunctions before they occur.

Rules 35, 101

Rule 35 requires that, in an emergency "*...when track is suddenly found defective or obstructed, any employee must by the use of flags, lights, torpedoes, fusees or other signals make every possible effort to stop trains in both directions*".[102] Rule 101 requires that trains and engines must be fully protected against any known condition, not covered by the Rules, which interferes with their safe passage.

Rules 35 and 101 are related in that each Rule deals with methods of assuring the safe passage of trains. If protection is required under Rule 35 it could be provided by train order, track occupancy permit or manual flagging, as the situation requires.

Rule 101 concerns train crews and is intended to protect portions of trains left standing on the main track against return movements of the remaining portion of the train. This would not be a problem in a cabooseless operation.

Cabooseless operations would not inhibit the proper application of these Rules although flagging requirements to the rear would be slower as all operating crew members would be in the locomotive cab.

The use of the emergency radio procedure discussed under Rule 102 could also be used at the discretion of the conductor when rear flagging is required.

Rule 44(d)

Rule 44 concerns the situation when the main track is found to be unsafe for movements at normal speed but safe for a speed of ten miles per hour or more. Paragraph (d) requires that trains stop and replace torpedoes on each side of the defective point, and reduce speed to ten miles per hour before passing the yellow signal and not increase speed until the entire train has passed the green signal. Two concerns are raised with regard to this Rule: first, how will flagging procedures be conducted and, second, how will the locomotive engineer know when his entire train has passed the green signal?

Rule 44 is seldom used in today's operation and, when it is used, it is only on subdivisions specified in time-table special instructions — usually on branch lines involving light density traffic.

Cabooseless train operation would not preclude the use of Rule 44. It would only mean that additional delay would occur while the trainman walked from the rear of the train to the head end after replacing torpedoes on each side of the defective point, where the Rule requires that torpedoes be replaced. The locomotive engineer, in making stops at the appropriate places clear of the points where torpedoes must be placed, would be guided by radio instructions by the trainman replacing the torpedoes.

Such a practice, while time consuming, would not be unsafe.

Rule 86

Rule 86 reads:

> *"Unless otherwise provided, an inferior train must be clear at the time a superior train in the same direction is due to leave the next station in the rear where time is shown, except that in ABS territory it must be clear in sufficient time to avoid displaying other than clear signal indications to a following superior train."*[103]

The questions with regard to this Rule relate to how it would be known when the train is clear of the main track, and how the train pulling out of the siding would protect itself while standing waiting for the trainman, who lined the switch for the main track, to walk to the head end.

A locomotive engineer on a train entering a siding in CTC territory could rely on the distance measuring device (DMD) to determine when his train is clear of the main track.

In CTC and ABS territory a following train cannot receive a clear signal until the train ahead is clear of the main track and the switch realigned for the main track.

In train order and MBS territory, where switches are manually operated, a crew member must detrain to line the switch before entering a siding and remain there to restore the switch to its normal position when the train is clear of the main track. In such circumstances the head end crew would rely on radio information from the crew member at the switch to determine when the train is clear. The crew member would then walk to the head end unless it is planned to back out of the siding after providing Rule 99 flag protection or obtaining the proper operating authority to do so.

When leaving the siding, the train would be protected by signals in ABS territory. In train order and MBS territory the railways would provide Form "U" protection or an MBS clearance to enable the train to remain on the

main track while the crew member walked to the head end after realigning the switch, unless protected by yard limits under Rule 93.

Thus, the requirements of Rule 86 could be observed as written in a cabooseless operation.

Rule 91

Rule 91 applies only in non-signalled territory and sets out certain intervals of distance or time that must be maintained between trains moving in the same direction. For a cabooseless operation, intervals would be maintained by radio between crews or with the dispatcher by means of train order protection or MBS clearance. Under these conditions this Rule could remain as is in a cabooseless environment.

Rules 99, and 152

Rule 99 outlines the action required when a train is stopped, or moving under circumstances in which it may be overtaken by another train. Rule 152 extends the protection prescribed by Rule 99 to situations where a train crosses from one track to another. Again, the question is raised as to how protection would be afforded in a cabooseless operation.

Rule 99 does not require flagging ahead or to the rear on single track in ABS and CTC territory where at least two block signals to the front and rear of the train are in operation.

In all other circumstances and in non-signalled territory, flagging, as specified in Rule 99, is required except where train order (Form U) protection is provided or the operation is in MBS territory where flag protection is not required.

If the railways are permitted to operate cabooseless trains in train order, non-signalled territory, then all trains would have to be protected by Form U train order.

In MBS territory, relief from Rule 99 is adequately provided by CN special instruction Form 696 item 2.19 and CP Special Instruction T in current time-tables. Both special instructions have been approved by the RTC.

Rule 152 requirements are easily met by providing flagging as required by Rule 99 from the front end of the train or alternatively by requesting train order (Form H) work order or MBS authority.

Rules 99 and 152 could therefore be observed by cabooseless trains in the same way as they are now observed by trains with cabooses. Under these conditions, Rules 99 and 152 are valid under a cabooseless train environment.

Rule 103

Rule 103 states that public crossings at grade must not be blocked for more than five minutes. The concern here is how operations may be arranged so that cabooseless trains will not block crossings for more than five minutes; how the crew at the head end of the train will know whether or not the crossing is in fact blocked and what could be done in an emergency situation to clear the crossing short of the five minute time limit.

As will be seen later, field tests established that the distance measuring device (DMD) has the capability to indicate the location of the rear of the train within a margin of error that is accurate enough for the purpose of clearing crossings.[104] In situations where it is necessary to cut a cabooseless train at a public crossing, a crew member would be required to detrain as the locomotive passes over the public crossing at grade in order to be in a position to make the necessary cut. Where more than one crossing has to be cut to avoid blocking by a long train, arrangements would have to be made to stop short of crossings, even if this entails delay to the operation.

Evidence was heard that where multiple cuts are made in a single train, it is not possible to re-couple all crossings, restore brake pipe pressure and move the train clear within the five minute period.[105]

These points are recognized as train operating problems but the situation would not change with cabooseless operations.

Since Rule 103 presently requires crew members to take the necessary precautions to avoid blocking crossings for more than five minutes, a crew member must at all times be in the vicinity of a blocked crossing in order to comply with the Rule. In view of this, the same crew member is in a position to take appropriate action to accommodate an emergency situation.

In all cases where the work to be done requires that train crew members not be in a position to comply with the Rule, then the work must be planned and arranged in advance to avoid blocking crossings. Not only is Rule 103 involved but section 251 of the Railway Act places a clear responsibility on the railway company to avoid the wilful blocking of public crossings for more than five minutes. Violations of this requirement should not be permitted either in the cause of operating efficiency or crew convenience.

It is the view of the Panel that Rule 103 is capable of application in a cabooseless train operation.

Rule 104

This Rule sets out the procedures for the handling of switches, and specifies that switches have to be lined back after the train has pulled through. There is a question as to how a cabooseless train would be protected while waiting for the trainman to return after having restored the switch back to the normal position.

In such cases, the rear of the train could be protected by Form "U" train order in train order territory, by signals in ABS, and manual blocks in

MBS, the same protection that now exists. Therefore, under these conditions there would be no deviation from the observance of these Rules as they are written, if the applications of CN and CP are granted.

Rule 111

Paragraph 1 of Rule 111 states that when other duties will permit, employees in the vicinity of passing trains must observe the condition of equipment of passing trains; trainmen at the rear of moving trains must be in position — on the rear platform where provided — and trainmen of standing trains must be in the best possible position on the ground from which a view of both sides of passing trains can be observed. Paragraph 3 of this Rule requires that trainmen at the rear of moving trains frequently look back at the track to see if there is evidence of dragging equipment, and paragraph 5 states that, when practicable, employees of a moving train must make frequent inspections of their train to ensure it is in order, and when a train stops, a trainman must be in a position to inspect the train as it pulls by. The concern is how the rear trainman is to fulfill these duties if he is at the front of a cabooseless train.

The railways contend that the duties outlined in paragraph 1 of Rule 111 can be fulfilled by a passing inspection by track force employees when on duty, and through the use of hot box and dragging equipment detectors (HBDE) where they are located.[106]

The requirements of Paragraph 3 and Paragraph 5 cannot be performed by trainmen on cabooseless trains, nor does the ETIS address this function. The railways plan to rely on the hot box and dragging equipment detectors to fulfill the requirements of Paragraph 3,[107] but the reliability and spacing of the HBDE's has been questioned by the Union and more will be said about this matter later. Pull-by inspections of cabooseless trains would be conducted by incoming crews at crew change points and any irregularities would be reported to the crew on the locomotive by radio. Run-by inspections would be provided by the crews of standing trains when meeting another train,

as currently required by Rule 111. The results of these inspections would be reported by radio to the crew of the moving train.

Although that part of Rule 111 requiring observation from the rear of the train would not apply in cabooseless operation, head end crews of passing trains would be required by Rule 111 to report the condition of their respective trains to each other by radio.

Rule 221

Paragraph 7 of this Rule states that a train must not proceed, without a clearance when the train order signal affecting it is in Stop or Caution indication, while any portion of the train is passing the signal. In a cabooseless operation, the conductor would be located in the cab of the locomotive and would accept the clearance from the head end of the train.

The operator would have to be instructed not to display the train order signal at Stop or Caution while any portion of a cabooseless train is passing the signal. If this procedure were to be implemented, there would be no need for cabooseless trains to comply with Paragraph 7 of this Rule.

Railway Company Air Brake Rules

In this respect, CP has said it will amend its rules for the Operation, Maintenance, Inspection and Testing of Air Brakes and Communicating Signal Equipment on Motive Power Cars and Work Equipment (CP RAIL FORM 582).[108] In particular, CP intends to make an addition to Rules 26A, 29A, 29B, and 29C — that being the following:

> *"Evidence that the brake pipe pressure has reduced on the rear car of a train due to a full service brake application on the locomotive, and that upon release of the brake, evidence that the brake pipe pressure is rising on the rear car of the train, will indicate that the brakes applied and released on the rear car of the train."*[109]

These CP rules at present require that the brakes on the rear car are known to have applied and released. (CP Form 582)

In CN Form 696, for a No. 2 Air Brake Test, for instance, item 17.5 states: *"...it must be known that the brakes on all cars added and on the rear car of the train apply and release"*.

CN stated that the conduct of the No. 1 Air Brake Test at the initial terminal by air flow method or pressure drop method will not change, if cabooseless train operation is permitted, except that the rear car brake pipe pressure would derive from the digital display of the ETIS transmission rather than from the radio transmission of the conductor's reading of the analogue pressure gauge in the caboose.[110]

CN, however, pointed out that the existing requirements for No. 2 and No. 3 Brake Tests must be liberally interpreted when applicable to a cabooseless train. The purpose of the present No. 2 Brake Test is to confirm the proper functioning of the brakes on those cars added to the train consist by observing the application and release of the brakes thereon and to ensure brake pipe continuity throughout the train by similarly observing the application and release of the brakes on the rear car of the train. The same continuity test requirement exists in the No. 3 Brake Test. CN pointed out that the observation of the application and release of the brakes on the rear car is not to verify the proper functioning of the brakes on the last car, which would have been confirmed during the No. 1 Brake Test; it is simply to verify continuity of the brake pipe.[111]

Continuity can be determined by the knowledge that the brake pipe pressure on the rear car responds to the brake valve handle movements in the locomotive cab, according to CN. It follows that, as the ETIS transmits rear brake pipe pressure to the locomotive cab, there is no need to observe the application and release of the rear car brakes when testing for brake pipe continuity, according to CN. CN contends that continuity is verified if rear car pressure reduces by an amount appropriate to a full service application and subsequently increases when the brake is released.

In support of this position, CN pointed out that the FRA amended Part 232 of the Code of Federal Regulations to permit the use of end-of-train telemetry devices as an alternative to visual inspection of the rear car during intermediate terminal air brake tests, on May 5, 1986.[112]

2.8 Public Interest

The National Transportation Policy

The Railway Transport Committee (RTC) is bound by the policy directives of section 3 of the National Transportation Act. The RTC sees it as its duty to ensure that the intent of this policy is upheld in all regulatory decisions irrespective of the subject matter of those decisions.

The policy fosters an objective of competition between modes of transport and therefore regulatory decisions by the RTC should be made in consideration of the impact those decisions may have on the competitive position of the railways vis-à-vis other modes of transport. The policy also prescribes, as an objective, the protection of the users of transportation and the economic well-being of Canada. It declares that an economic, efficient and adequate transportation system making the best use of all available modes of transportation at the lowest total cost is essential in meeting these objectives. These statutory objectives also point out the requirement to ensure that the interchange of commodities, and the development of industry and export trade are not unduly obstructed. The RTC must therefore examine applications, on matters such as proposed modifications to, or deletions or relief from the UCOR, from many more perspectives than those of a single interest group(s) and must consider more than the technical aspects of operational changes.

The UTU argues that the powers of the Commission to regulate safety are derived solely from the Railway Act, which does not refer to the economics of the railway companies as far as public safety is concerned. They refer to the new national transportation legislation which states that the national transportation system must meet acceptable safety standards.

The UTU further argues that *"acceptable safety standards"* must mean standards acceptable to the public, not to meet a minimal criteria that is safe in the opinion of the railway companies.[113]

One of the most important dimensions of all RTC safety decisions is the public interest. When dealing with a matter having implications to safety, in part that means protection of the public from the hazards of train operation. In this respect, several parties during the hearing referred to the "Show Cause Hearing Decision on Railway Safety" dated September 30, 1981, that followed the Grange Inquiry into the Mississauga Accident which dealt with this matter as follows:

> *"The protection of the public involves protection from some risk and risk is by its nature a matter of more or less likely possibilities. The possibility of eliminating all risk of railway accidents exists only in closing down the railways — an option that no one seriously supports. This is not to say that all hazards can be casually ignored just because some risk taking is inevitable, but that taking extravagant measures to reduce each and every risk is not sensible. As well, reducing risks by one means in one area may increase cost greatly without reducing risks overall. The prudent course is one which balances the benefits of net safety improvement against the costs necessary to achieve the improvement, taking into account the public perception of what level of overall risk is acceptable.*
>
> *It is also necessary to consider that in the public mind the acceptability of risk can vary with the type of risk and so affect the level of precaution deemed necessary. Perceptions of the relative dangers of different courses of action are not always logical. A statistically high risk of grave injury would appear acceptable to most where there is an element or an illusion of personal control but not where anonymous forces may act. For instance, people who chain-smoke cigarettes could still be eager to obtain vaccinations against swine flu. Significantly, people will take great alarm about events that rarely occur but may involve a number of people at once, yet the public seems to have less concern for incidents which occur very frequently though claiming only one victim at a time. An airplane crash (which occurs relatively infrequently) generates demands for huge investments in new safety devices while the same investment in teaching emergency treatment for heart attacks may save many more lives.*

The Panel concludes that, in light of these considerations, to impose a tax on one sector of the economy in order to attain an anomalously low risk relative to the general risk accepted by the public in every day life does not make sense".[114]

This statement, in combination with the national transportation policy, indicates probably as best as can be described the Railway Transport Committee's responsibilities concerning the public interest aspects of safety-related decisions. It also implies the high level of difficulty encountered in making safety-related decisions which are both reasonable to the public and fair to the regulated private or crown corporation.

The railways in this case contend that the existing level of safety will not be diminished by a change to cabooseless operations but that cabooseless operations will generally be good for the economy as a whole and hence good for the public at large.[115] The UTU states that safety will be reduced by cabooseless operations and that economic considerations are not relevant to this case; hence a granting of the applications would be contrary to the public interest.[116]

Apart from the matters of safety and economic benefits to CN and CP, there are several other major results of a transition to cabooseless operations that could be considered as having an impact on public interest.

Labour Force Reduction

Both carriers testified that the rear train personnel would be moved to the front of the train and would not be removed from the train consist as a result of a shift to cabooseless operations. According to CN and CP, there will therefore be no employment reduction in the running trades if their applications are granted in the foreseeable future.[117] CP, however, pointed out that there would be a net annual reduction of about 500 person-years mainly in the caboose maintenance functions.[118] The net annual reduction in the railway labour force on CN is estimated to be 520 person-

years,[119] for a total of 1,020 person-years reduced as a result of a change to cabooseless operations.

Benefits to the Shippers

As the Western Grain Transportation Act (WGTA) rates are calculated on the basis of Canadian Transport Commission approved costs and, as the costing method would identify reduced costs arising from cabooseless operations, such savings as do exist for grain moved under the WGTA would be passed on to the grain farmer and to the Government and hence to the taxpayer. In this respect, CP estimates that the WGTA rate reduction would be in the order of $0.51 per tonne at the 1986 wage and price levels.[120]

It is not possible to estimate the degree to which other rates may be reduced or maintained at a lower rate if cabooses are removed since railway rates are not always based on costs. For instance, when asked to provide an example of a rate reduction resulting from a cost reduction to the railways, the Canadian Pulp and Paper Association could not do so.[121] The railways maintain, however, that the savings would increase their respective investment funds to permit plant and equipment upgrading so as to maintain and increase efficiency and reduce their costs and thus they could become more price and service competitive[122] — something that should benefit shippers who can avail themselves of competitive transportation services. There is also the possibility that the resultant additional revenues would theoretically reduce the upward pressure on rates to captive shippers where no competitive transportation services exist. Furthermore, it is possible that the savings could be used to improve safety.

Benefits to Government

Apart from the automatic reduction in WGTA rates with the attendant reduction in Government grain transportation payments, to the extent that marginal net taxable income increases, railway taxes will also increase.

2.9 Railway Safety

What is "Safety"?

"Safety" of railway operations is often referred to and yet its meaning is rarely made clear. Statements made by parties at the hearing such as *"Railway safety must remain at the current acceptable level"*, or *"The changes can be made without a reduction in safety"*, or *"The modifications are consistent with railway safety"*, or *"there must be acceptable safety standards"*, and so on, are all commendable but carry meanings that vary from one person to another. It is therefore essential to consider the views of others and to define in unambiguous terms what the Panel means by safety.

The UTU stated that it *"...divides railway safety into two distinct and separate categories as follows:*

> *(a) the basic preventative maintenance and efficiency of track, cars, locomotives, equipment, signal and communications systems, radio equipment, hot box detectors, dragging equipment detectors, slide detectors, railway crossings, railway bridges, etc., and;*
>
> *(b) the immediate on-going safety of freight trains as they move across Canada from terminal to terminal, the immediate on-going safety inspection of trains by qualified inspectors at terminals, interchange points, etc., the inspection of trains in marshalling yards, locomotive braking systems, etc., the emergency correction of faulty hot box detectors, dragging equipment detectors, slide detectors, radio equipment, signal systems, railway crossings, track patrol; by maintenance of way employees, etc".*[123]

The UTU contends that the railways' applications deal only with rail safety as stated in category (b) above.[124]

There is little doubt that what the UTU is referring to here are two categories of ways to prevent accident and injury through maintenance, repair, inspection and observation. Some would argue that "safety" is the product or result of such categories.

The UTU goes on to say that railway equipment efficiency and use of modern technology reduces the probability of accidents. In particular, the following was said:

> *"However, the reduction of the probability of an accident is not sufficient. Railway accidents are as a result of the unforeseen or an emergency situation that no amount of, before the act, maintenance or technology can predict. Logically this must be valid. If it were not the case, then railway accidents would now be a thing of the past."*[125]

Here, safety is cast by the UTU in terms of reducing the probability of accidents and the recognition that all accidents cannot be prevented and therefore, in the Panel's view, the UTU indirectly appears to recognize that the highest practical level of railway safety is not an accident-free railway.

The UTU contends that:

> *"...to delete one ingredient from the combination of elements that ensure the existing level of safety of railway operation must result in a lowering of the present level of safety."*[126]

Here, it is suggested that safety is a product or perhaps the sum of a number of inputs or "ingredients", the removal of one of which will reduce safety. From this, however, it flows that in order to assess a safety-related application for regulatory change, one must first determine that the ingredient to be changed or to be deleted is, in fact, something that acts to maintain the present level of safety.

The UTU also contends that:

> *"The Canadian Transport Commission must ensure that the railways are not only a safe operation but the safest operation reasonably possible in the public interest. The term reasonably possible must of course take into consideration the economic viability of the Applicant's overall operation".*[127]

Here, a concept evolves that the highest level of safety is bounded by the economic viability of the railway. And yet, the Union also states in a somewhat conflicting way that:

> *"...the economics of the railways, at any given point in time, is of no relevance to the level of safety of operation, which is the sole mandate of the Railway Transport Committee, when the public and employee safety is being considered".*[128]

Further on safety, the Union states that:

> *"...if there is any reasonable doubt that the level of safe operation is to be reduced, the Commission is duty-bound to rule on the side of public safety".*[129]

From this, and in consideration of the above, it could be said that the Union favours a situation where the RTC may consider the economic viability of the railways when imposing regulatory change to improve safety but should not when considering an application by the railway for change that may reduce safety.

It is the Union's position that:

> *"...the onus rests with the Applicants, not only to demonstrate that a cabooseless train operation is safe, but meets the level of safety of operation in place now, which is a complement of technology and Rule 90A and other provisions of the UCOR".*[130]

If this is so, then an adequate measure of the existing level of safety is required just as much as it is required to find an adequate means to measure the safety resulting from that which may not yet have been tried.

The British Columbia Caboose Committee (BCCC) states that the RTC must focus on the public perception of safety, and they contend that society demands that expenses be incurred to protect the public from unlikely events.[131]

The Saskatchewan Keep the Caboose Committee (SKCC) states that cabooseless operations are not perceived by the public to result in an acceptable overall risk. They also point out that legislation does not direct the RTC to balance economics against safety, but rather to ensure the protection of the public and property. Therefore, they contend that economic considerations are largely irrelevant.[132]

In the Panel's opinion, safety means the state of "being uninjured" or "free from or not exposed to danger or risks". A member of the public, including a passenger on a passenger train, is only exposed to danger by train operation when he or she is located at or near: a) a railway crossing; b) a derailment site; or c) a collision site. In the absence of these three factors, the public would be totally safe in respect of train operations, except for those members of the public who choose to trespass on railway property. Railway employees, on the other hand, are exposed to danger by train operation principally in those three locations, and during the starting and stopping of trains. There are therefore two dimensions to railway safety: one as it applies to the public, and one as it applies to railway employees.

The Panel therefore considers that railway safety could be defined as follows:

> *"Railway safety is the degree to which each individual is protected from incurring physical injury as a direct or indirect result of encountering or being in proximity to a train at a level crossing, or at the site of a derailment or collision; or in the case of railway employees, the degree to which each employee is protected from incurring injury while on duty."*

Railway Safety Measurement

In order to discuss railway safety in a quantitative fashion, a means of measuring "safety" or "level of safety" must first be selected — and there can be many such measures. Since the most critical result of an unsafe condition is personal injury or death, the ultimate measure of safety of a particular system is the frequency of death and injury resulting from the conduct of that system's functions. In the case of determining the level of railway safety for a particular railway, the annual number of deaths and injuries resulting on that railway from: a) level crossing accidents, b) derailments, c) collisions, and d) other causes, would be a reasonable measure. If possible, a more sophisticated measure might include further break-down as to railway region, thereby indicating regional differences in risk which may or may not be a result of something the railway or anyone else could resolve.

A reasonable measure of the existing level of railway safety and related comments are found in Appendix 5.

Railway Safety Trends

Trends in safety are often used to draw comparisons of the success of one carrier relative to another in the improvement of safety. Quite often comparisons are drawn between Canadian and United States railways and the following reflects the safety trends of CN, CP and their United States counterparts.

Table 9

TRAIN ACCIDENTS*

(Number per million train-miles)

Year	U.S. Class I Railway Average	CN	CP
1972	9.65	8.61	5.31
1973	11.10	9.91	5.34
1974	12.63	11.84	6.69
1975	10.38	7.78	5.63
1976	12.90	7.97	6.57
1977	13.60	6.94	4.97
1978	14.91	6.51	5.22
1979	12.63	6.86	4.71
1980	11.58	5.23	5.34
1981	8.33	5.40	4.68
1982	7.77	5.78	5.30
1983	6.96	5.35	3.18
1984	6.97	4.67	2.76
1985	5.95	3.86	2.07
1986	4.99	3.39	2.08
1987	N/A	N/A	N/A

*Federal Railroad Administration (FRA) reporting basis including train and yard truck, motor, car track unit, crossing accidents over monetary value set by FRA in U.S. dollars.

Sources: Exhibits CN-42 and CP-62.

Table 10

FRA ACCIDENT RATE REDUCTION*

Railway	Percentage Since 1974
CN	67.4
CP	69.1
U.S. Class I	52.9

*Note: Percentage was determined by subtracting current accident rates in the previous table from the base year accident rate divided by the base year accident rate, e.g. for CN since 1974 reduction = (11.84 - 3.86) / 11.84 = 67.39%.

Source: Previous table.

From the above trends the following can be adduced:

1. Except for 1980, CP has realized fewer accidents per train-mile than CN and sometimes by a considerable proportion. From this it could follow that the risk of accident on CN is greater than on CP and that, on this basis of safety measurement, CP is safer than CN.

2. Both CN and CP have consistently had fewer accidents per train-mile than the average accidents per train-mile realized by US Class 1 railways and, therefore, on this basis of safety measurement, CN and CP could be considered to be safer than their American counterparts.

3. Accident rates appear to have risen to a peak in the mid-1970s followed by a general decline to present.

4. Since 1974, CN and CP have proportionately reduced their accident rates significantly more than United States Class I carriers on average.

Impact of Change on Safety

The accurate assessment of the impact of proposed change on safety is an elusive goal. If there is a precedent situation where the proposed change has been made and the resultant impact on accident rate and death/injury rate has been recorded over a reasonably long period of time, with all other factors remaining equal, then that experience can be used to forecast the impact on safety of a proposed change on other similar systems. Without precedent information such as this, there is little choice but to conduct tests on the system where the change is proposed — usually on a sample basis.

In the case of the CN and CP applications for changes to the UCOR and the applicability of certain provisions therein, the potential change is the removal of the caboose and the relocation of the rear crew to the head end of the train on all freight trains on CN and CP. The most comparable precedent to this proposal is the operation of cabooseless trains in the U.S. — an experience which is not based on 100% cabooseless operations and generally not based on climatic conditions similar to that experienced by Canadian railways. It was previously concluded by an RTC panel in the Decision on Testing Cabooseless Operations dated September 1985 that "... *we find the experience of other railways in operating cabooseless trains valid and useful for comparisons*".[133] However, such precedent information was not considered sufficiently compelling to form the sole criterion for a decision on the subject applications.

Recognizing the difficulty of assessing the impact of proposed change, that same panel said "... *The hypotheses and views of what may happen*

must be tested so that a well founded final decision can be made".[134] The ETIS had not undergone independent testing as to its accuracy and reliability prior to 1985. No specific measure had been made of the safety functions, if any, that would not be provided in cabooseless operations. As a result, it was decided by the RTC that a test program would have to be carried out to provide the quantitative data necessary to evaluate the impact of the proposed changes on the level of railway safety. Those test programs, the results and the related analyses are dealt with in Chapter 3 of this Decision.

The Cost of Accidents

As will be seen later, the UTU contends that the economics of change on a railway should consider the cost of accidents that may arise from that change.[135] In this respect, the Union presented the following data on accident and accident cost trends.

Table 11

ACCIDENT TRENDS

Year	Accidents*	Million Train-km	Accidents Million Train-km
1977	1,164	98.5	11.82
1978	1,145	100.6	11.38
1979	1,270	102.2	12.43
1980	1,124	100.4	11.20
1981	1,151	98.1	11.73
1982	1,039	84.9	12.24
1983	847	89.0	9.52
1984	921	96.0	9.59
Average	1,083	96.2	11.26

*Including derailments, collisions and crossing accidents as reported to the CTC.

Source: Exhibit CRLA-UTU 112, Pages 92, 93.

Table 12

COST OF ACCIDENT TRENDS

Year	($ Million) Loss, Damage & Other Casualty Expense	($ Million) Railway Expense	%	Accident Expense/ ($ Per 1,000 Train-km)
1977	60.8	3,493	1.74	617
1978	33.4	3,855	0.87	332
1979	56.1	4,331	1.30	549
1980	73.0	4,756	1.53	727
1981	79.7	4,739	1.68	812
1982	80.7	4,995	1.62	951
1983	61.0	5,265	1.16	685
Average	63.5	4,490	1.41	660

Source: Exhibit CRLA-UTU 112, Pages 92, 93.

This indicates that, at present, the cost of accidents at the present level of safety is roughly 1 to 1.5% of the railways' total expenses for about $600 to $700 per 1,000 train-km.

2.10 Summary

The foregoing documented an overall perspective of the issues surrounding the applications by CN and CP in respect of certain provisions of the UCOR. In the Panel's opinion, consideration of that leads to a number of questions that need to be answered in order to come to a decision on whether or not to grant those applications. These questions, in their most general form, are as follows:

1. How accurate and reliable is the ETIS equipment?

2. What are the risks, if any, of removing the caboose and relocating the rear crew to the locomotive cab?

3. What is the net change in safety that would arise from a transition to cabooseless operations?

4. What are the variations in that net change to safety under different conditions?

5. What is the public interest associated with the proposed cabooseless operations?

3.0 THE NEW TECHNOLOGY (END-OF-TRAIN INFORMATION SYSTEM)

3.1 General

The new technology that catalyzed the plans of CN and CP to operate cabooseless trains is an electro-mechanical device which performs several functions now carried out by the rear crew in the caboose. This device is generally referred to as the end-of-train information system or the ETIS.

Two types of ETIS were tested by CN and CP in respect of this case: first the Digitair I model and then, when it became available in late fall of 1986, the Digitair II model. Both models were produced by Dynamic Sciences Limited (DSL) of Vancouver, B.C. Both CN and CP are committed to employing the Digitair II system if they are granted the changes to operating rules which would permit cabooseless operations.

3.2 Basic ETIS Design

Digitair I Components

An ETIS has two basic components. To the rear of the train is a sense and transmit unit (STU) which senses the brake pipe pressure at the last car and transmits that pressure by radio to the receive and display unit (RDU) located in the locomotive cab.

An ETIS can have other functions as well, including:

a) a battery operated marker light to indicate the rear of the train;

b) a distance measuring device (DMD) similar to an odometer;

c) a rear train motion indicator;

d) a buff/draft indicator which signifies whether the cars of the train are compressed together or stretched out;

e) a device which permits placing the train brake into emergency from the rear of the train by radio signal initiated from the locomotive cab.

The Digitair I system is essentially the same as the Digitair II system with the exception that the latter includes the rear emergency brake feature.

More specifically, the Digitair II or Digitair Series 6650 of ETIS is described in the following.

Digitair II Components

DSL describes the Digitair II system as follows:

"The DSL 6650 Series DIGITAIR System (DIGITAIR II) consists of a Sense and Brake Unit (SBU) mounted on the last car of the train, and an Input and Display Unit (IDU) and a Communications Logic Unit (CLU) installed in the locomotive. The IDU provides the locomotive engineer with a digital display of the brake pipe pressure at the rear of the train, as well as an indication of motion of the last car (moving/stopped) and the direction of motion on start. If a highly visible marker (HVM) light is fitted on the SBU, the on/off status is displayed, as well as the condition of the batteries. The SBU telemetry battery status and other warnings about brake pipe pressure are also given.

In addition, the System provides the engineer with the ability to give an emergency application of the brakes at the rear of the train. The status of the SBU circuitry which controls this function is displayed on the IDU.

An optional odometer, started and stopped by the locomotive engineer, provides a ready measure of the distance travelled by the locomotive."[1]

Pictoral displays of the IDU, CLU and SBU components follow.

It is not intended here to discuss the detailed design of the Digitair series of ETIS. Rather, certain features that have a strong bearing on the assessment of safety of ETIS usage are emphasized.

Self-Diagnosis

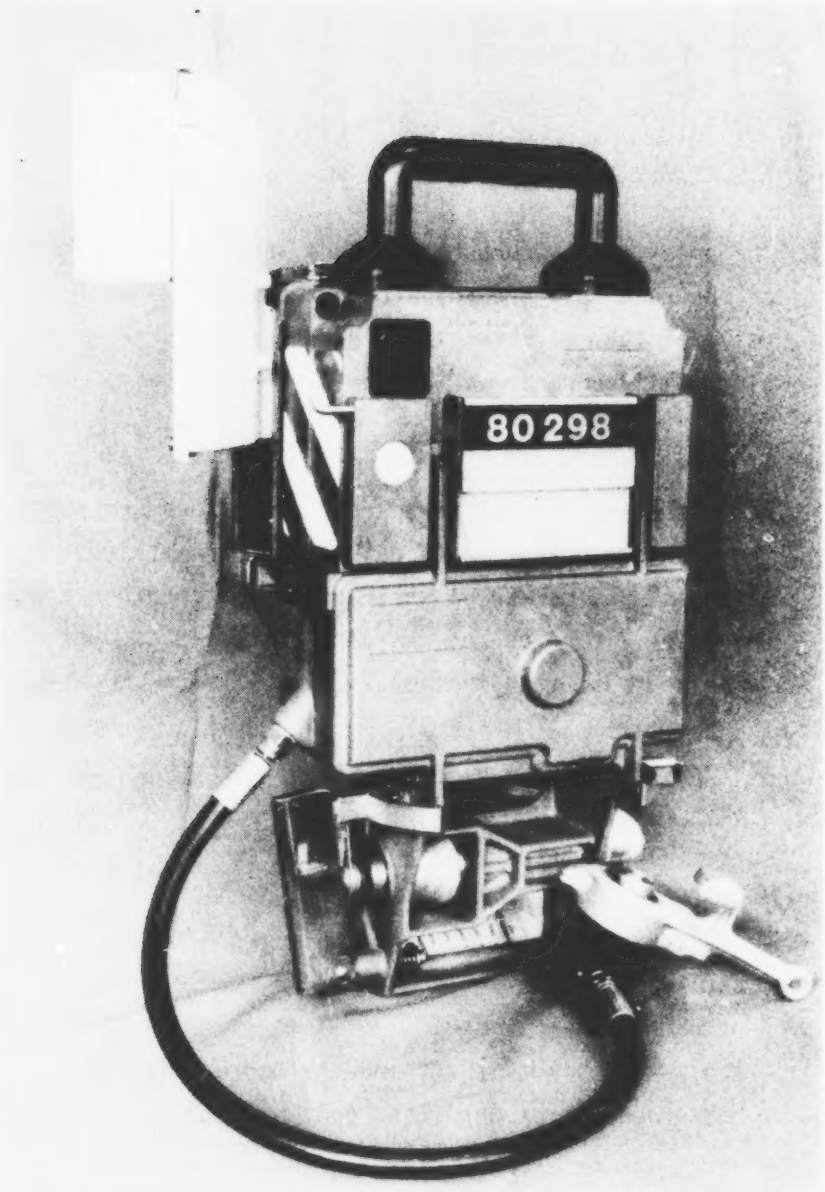
When the power is first applied to the IDU and CLU, they go through a series of self-diagnostic tests to ensure proper functioning. As well, the CLU sends a status update request to the SBU automatically every 10 minutes. The purpose is to test the front-to-rear radio link. No indication appears on the display if the SBU replies immediately. If a reply is not received, the CLU sends another request 15 seconds later. If there is no response to this re-try another transmission is made in 6 minutes. If there is no response to this request, a final transmission is made 15 seconds later. A front-to-rear No Communications Alarm will appear if the SBU does not reply to this last request. This is important as it indicates that the rear emergency brake feature may not activate.

Identification Code Selection

Each SBU has a unique identification code which is a part of every radio message it sends. This code must be set on the IDU in the locomotive cab for front to rear and rear to front of train communication to be possible. This way, other ETIS radio transmissions, which will all be on the same radio frequency, will not be mistaken either by the IDU or the SBU unit employing a different code.

REAR UNIT CODE
DIGITAIR
MODEL 6653
INPUT & DISPLAY UNIT
COMM TEST
BATT
LIGHT
COMM
VALVE
MOTION
BRAKE PIPE PRESSURE
DSL
DISTANCE
EMERGENCY

DIGITAIR
MODEL 6652
COMMUNICATIONS LOGIC UNIT
DSL


80 298

IDU Displays

A number of displays are possible on the IDU:

a) Pressure Display

The pressure in pounds per square inch (psi) in the brake pipe of the rear car is displayed on the IDU to a maximum of 125 psi. If the rear brake pipe pressure drops below 45 psi an alert will sound and a low pressure signal will display for 5 seconds.

Radio transmission of pressure readings are sent/received when the pressure changes by 5 psi or more and at least 2 seconds have passed since the last transmission, or when a pressure change of 2 to 4 psi occurs and at least 5 seconds have passed since the last transmission.

b) Marker Light Status Display

Marker light status displays indicate:

- the marker light is on and the marker light batteries are properly charged;

- the marker light is off and the marker light batteries are properly charged;

- the marker light is on and the marker light batteries are weak;

- the marker light is off and the marker light batteries are weak.

c) Telemetry Battery Status Display

When the battery that operates the radio transmitter in the SBU becomes weak (with about 12 hours of operating life remaining) a visual warning (W) is given on the IDU. When very little capacity is left another warning (F) is given.

d) Motion Display

A different motion display is given for each of the following conditions:

- forward movement;
- reverse movement;
- continuous motion; and
- stopped condition.

e) Emergency Brake Feature Status Display

When the rear train emergency brake feature is activated by applying the emergency switch on the IDU, indication is first given that front to rear radio transmission has occurred and when the rear emergency valve has been opened the pressure display reads zero.

f) Communications Test Display

When end to end radio communication is tested, successful communication is displayed on the IDU.

g) Odometer Display

The odometer may be calibrated over a known distance. During this process the train is run over a known distance of one (1) mile with a calibration button on the IDU activated at the beginning of the run and deactivated at the end of the run. The odometer can then be calibrated if the measured distance is within an acceptable range of a mile. The odometer is activated when the distance button on the IDU is depressed and a display of distance travelled in feet is given on the IDU. Calibration is possible for wheel diameters of 36 inches to 42 inches.

h) Automatic Marker Light Test Display

An option to Digitair II is an automatic marker light test which allows the locomotive engineer to check if the marker light is functioning properly, day or night.

i) Communications Failure Display

A display on the IDU and an audible alarm will sound for 5 seconds when there is a failure in rear-to-front communications and then a display of the identification code of the last received transmission will occur.

When there is a failure of the front to rear communications, a visual and audible alarm will occur for 5 seconds with the identification code display; 15 seconds after rear emergency has been activated or 6 minutes and 30 seconds after an automatic communications test from the CLU.

j) Emergency Valve Circuit Failure Display

If the emergency valve circuit in the SBU fails, the IDU will give an audible and visual alert.

k) Other Displays

The IDU will display different warnings if:

- there is no pressure at the rear car brake pipe for 5 minutes;
- the CLU is faulty;
- the communication between the CLU and IDU has failed.

The internal display on the SBU will display the following:

- a power-on indication;
- the pressure sensed in psi;
- telemetry battery status (okay, weak, failing, failed).

Digitair II Batteries

The battery that operates the SBU radio receiver/transmitter is of a 12 volt 4 amp-hour rechargeable nickel-cadmium variety.

Three more of these same batteries are used to operate the marker lights.

If they are well cared for, these batteries have a lifetime of 1,000 charge-discharge cycles or more.

Their respective discharge time in operation is as follows:

Table 13

OPERATION LIFE CYCLE

(hours)

	SBU Telemetry Battery*		SBU Marker Light Batteries	Marker Light Bulb
Normal	150		60	500-1000
At - 40°C	72	(minimum)	24	500-1000

*DIGITAIR II

Source: DSL, Mr. R. Heenan.

Their shelf-life is limited as they lose 30% of their capacity in the first 24 hours and, following that, 10% per month.

3.3 The ETIS Tests

In its September 16, 1985 Decision on the testing of caboose less operation, the RTC required a test to be done on the ETIS and associated devices to evaluate the reliability of the following ETIS functions:

- rear car brake pipe pressure monitoring;
- radio transmission;
- coding and identification systems;
- rear-of-train emergency brake application from control locomotives;
- distance measuring device;
- battery life;
- direction/motion indicator; and
- rear-of-train electric light and reflective marker to conform with UCOR 19A.

It was also stipulated by the RTC that the tests should take into account the effects of the following conditions:

- ambient temperature/change;
- snow accumulation;
- terrain, e.g. hills, cuts, curves, foliage, buildings, etc.;
- overhead power lines;
- extraneous radio transmissions; and
- trains on adjacent tracks.

A detailed test plan was developed by RTC staff in consultation with representatives of the railways and unions and was provided to all parties on November 12, 1985. The test plan outlined five test programs described below:

1. Test Trains Utilizing End-of-Train and Associated Devices - Equipment Tests;

2. Test Trains Utilizing End-of-Train and Associated Devices - Rear Train Crew Functions;

3. General Train Runs - Rear Train Crew Functions;

4. Laboratory Tests; and

5. End-of-Train Device Installation Tests.

3.4 Reliability Tests of Proposed ETIS Equipment

General

Test Program No. 1 (Test Trains Utilizing End-of-Train and Associated Devices Equipment Tests) results pertaining to Digitair I performance were published by the RTC on September 18, 1986.

Digitair I was tested on test trains such that:

a) the test trains would not operate at a specified time (such as day or night);

b) ordering times would not be altered;

c) no specific type of traffic would be selected for or excluded from testing;

d) test trains would receive normal inspections;

e) test trains would be operated over different types of geography, every type of trackage of both railways, and under every type of traffic control system.

General discussion, data analysis, and conclusions with respect to the performance of each of the principal functions of Digitair I follow:

Remote Brake Pipe Pressure Monitoring

The difference between the brake pipe pressure at the rear car and that at the locomotive is known as the "brake pipe gradient" or "taper". Theoretically the gradient should be zero indicating that the brake pipe is completely air tight throughout the train. In reality, it is not zero as there is almost always some brake pipe leakage.

A standing air brake test requires that the gradient or taper not exceed 15 psi before commencing with the balance of the test. Normally, the rear train crew would relate the rear car brake pipe pressure to the head end crew so as to ascertain the pressure gradient in the brake pipe. In cabooseless operations, the rear brake pipe pressure would be sensed from the rear car by the sense and brake unit (SBU) of the Digitair II system and transmitted to the communications logic unit (CLU) and displayed on the input

and display unit (IDU) in the lead locomotive cab. The gradient would then be determined by the locomotive engineer.

Tests were conducted to determine what the gradient was prior to brake tests, when train brakes were applied, and during en route brake tests or observations en route. This test assumed that the ETIS was accurate and really only reflected whether or not the gradient determination procedure could be accomplished on a cabooseless train. There were relatively few instances when the recorded gradient exceeded 15 psi. Those failing instances indicated either excessive gradient or a faulty ETIS (pressure sensing at the rear too low). The results follow:

Table 14

INSTANCES WHERE GRADIENT WAS MEASURED IN EXCESS OF 15 PSI

	RTC(1)	CN(2)	CP(3)	CN/CP
A. Prior to Brake Test				
-Number Reports	3250	1218	2071	3289
-Number greater than 15 psi	22	4	0	4
-Percent greater than 15 psi	0.7	0.3	0.0	0.1
B. Train Brakes Applied				
-Number Reports	3250	1173	2071	3244
-Number greater than 15 psi	13	6	0	6
-Percent greater than 15 psi	0.4	0.5	0.0	0.2
C. Intermediate/Enroute Test				
-Number Reports	3250	2968	2071	5039
-Number greater than 15 psi	82	32	0	32
-Percent greater than 15 psi	2.5	1.1	0.0	0.6

(1) Source: Exhibit CTC-1C, Page 5. Note: Includes both CN and CP according to RTC staff criteria.

(2) Source: Exhibit CN-8, Page 65.

(3) Source: Exhibit CP-16, Page 2. Note: 0 reading does not mean that there were no instances but that CP did not record same.

CN concluded that those instances where the gradient exceeded 15 psi prior to brake tests "*...are instances where the test was inadvertently commenced prematurely.*"[2] In other words, the test commenced before the train was completely charged.

With respect to those instances where the gradient exceeded 15 psi when train brakes were applied, CN states "*It would be surprising if the overall results were significantly different from the results of the gradient prior to the brake application.*"[3]

CN also feels that the 15 psi plus gradient en route indicates "*...the dynamic nature of the rear pressure which must necessarily lag the front pressure during the reduction cycle when brakes are applied and during the recharge cycle after brakes have been released.*".[4]

CP provided no analysis of instances where the gradient was in excess of 15 psi as they contended that a comparison between the locomotive brake pipe gauge and the gauge in the caboose has no bearing on the reliability of the ETIS and associated devices.[5]

Digitair I - Radio Transmission and Display of Pressure Accuracy

The STU has a pressure display feature which permitted the test of the accuracy of the display and the radio transmission of sensed air brake pressure on the rear car.

CN is of the opinion that "*...the only conceivable difference between these two displays (at the STU and the RDU) is the result of readings observed at different times during periods of changing rear brake pipe pressure*".[6] A comparison of the STU and the RDU display readings could also, theoretically, give an idea of the accuracy of the radio transmission and display of sensed pressure readings. Practically speaking, CN points out that "*...a corrupted message will not generate an incorrect pressure display.*".[7]

A comparison of the two displays were made: a) immediately prior to brake tests; b) when train brakes were applied; and c) during intermediate tests or en route observations. The data was placed on a form and the collation of the data by different parties follows:

Table 15

COMPARISON OF STU AND RDU PRESSURE DISPLAYS

	RTC(1)	CN(2)	CP(3)	CN/CP
A. Prior to Brake Test				
-Number Reports	3250	1217	2071	3288
-Number Not Equal	345	115	262	377
-Percent Not Equal	10.6	9.4	12.7	11.5
B. Train Brakes Applied				
-Number Reports	3250	1214	2071	3285
-Number Not Equal	525	201	337	538
-Percent Not Equal	16.2	16.6	16.3	16.4
C. Intermediate Tests/Enroute Observations				
-Number Reports	3250	728	2071	2799
-Number Not Equal	338	86	64	150
-Percent Not Equal	10.4	11.8	3.1	5.4

(1) Source: Exhibit CTC-1C, Page 5. Note: Includes both CN and CP according to RTC staff criteria.

(2) Source: Exhibit CN-8, Pages 68/69/70. Note: CN differentiated the number of reports received under each category whereas RTC and CP did not, employing the total number of reports received as a base criteria. The CN percentage figures are therefore more representative.

(3) Source: Exhibit CP-16, Table B. Note: The number of reports received are employed rather than the number of instances when an observation was made, the percentage figures therefore are low in terms of providing an indication of the proportion of times when the readings would differ.

From this it can be seen that, for a rather significant percentage of time, the pressure display on the STU differs from that on the RDU. In theory, the processing and/or radio transmission and/or receipt and display of the transducer signal at the RDU somehow alters the pressure reading relative to the processing and display of the transducer signal at the STU. DSL however explained that this is not possible. DSL feels that it is likely that variations in pressure displays could be due to the fact that a change of 1 psi is transmitted only every minute and a change of 2 to 4 psi every 5 seconds.

Similarly, CN is of the opinion that, when differences occurred, they resulted from a time lapse between the observation of the STU display and the RDU display, recognizing that the pressure at the rear "*...requires about 3 minutes...to settle to the long term pressure level*".[8]

CN also pointed out that only 2% to 3% of the tests resulted in reported differences in excess of 3 psi.[9] RTC staff in its presentation of the test data commented that the number of failures decreased substantially when a 3 psi difference rather than a 0 psi difference was the test failure criteria.[10]

CP concluded that "*...unless the readings from the two sources (the STU and the RDU) are taken simultaneously, they will not be the same due to the brake pipe pressure fluctuating due to leakage, charging or ambient temperature change.*".[11]

DSL is of the opinion that if the head end reading was radioed back and then the STU or SBU pressure test button was pressed, the signal would be transmitted which could interrupt the 5 second time cycle resulting from a 2 to 4 psi change.

Digitair I - Use in No. 2/3 Air Brake Test

One current facet of a No. 2/3 air brake test is that the brakes on the rear car must be known to apply and release. If there is no crew member

positioned at the rear of the train, as would be the case with caboose less operations, the functioning of the brakes on the rear car cannot obviously be verified without a crew member walking the length of the train. One has to consider that the reason for requiring the observation of the functioning of the brakes on the rear car is to determine whether there is continuity in the brake pipe and not to determine whether the brakes on the rear car are functioning properly.

Assuming minimum leakage and normal ambient temperature, when the full service brake application is made, the pressure in the brake pipe, auxiliary reservoir and brake cylinder tend to equalize at about 50-55 psi. At the commencement of a brake release, a pressure wave propagates down the brake pipe and the AB, ABD, and ABDW brake valves initiate a release cycle in the brakes when the brake pipe pressure rises 1.5 to 1.75 psi above the auxiliary reservoir pressure at each car. The brake pipe pressure then rises very rapidly and then falls off slightly as the auxiliary reservoir starts to recharge. When the major parties to this hearing considered what tests should be carried out it was thought that, if the rear brake pipe pressure rose about 5 psi, the brakes on the rear car could safely be assumed to be released and, more importantly, that brake pipe continuity existed. This then gave rise to a test whereby the brakes on the rear car were observed in conjunction with the brake pipe pressure as read from the RDU in the locomotive cab.

A tabulation of results as collated by certain parties follows:

Table 16

FREQUENCY OF REAR CAR BRAKES NOT BEING OBSERVED TO RELEASE AFTER AN INCREASE OF 5 PSI IN REAR BRAKE PIPE PRESSURE

	RTC(1)	CN(2)	CP(3)	CN/CP
-Number Reports	3250	1116	2071	3187
-Number Not Released	1895	713	1244	1957
-Percentage Not Released	58.3	63.9	60.1	61.4

(1) Source: Exhibit CTC-1C, Page 5. Note: Includes CN and CP according to RTC criteria.

(2) Source: Exhibit CN-8, Page 76. Note: Includes only forms reporting a test whereas RTC and CP "Number Reports" is the number of forms received.

(3) Source: Exhibit CP-16, Page 2. Note: The number of reports is the number of forms received.

The data indicates that in 60% of tests the rear car brakes were not observed to release — even though the brake pipe pressure had risen 5 psi. This then places in question the assumption that a 5 psi rise in rear car brake pipe pressure as indicated in the locomotive cab means that the rear car brakes have released. This does mean, however, that a 5 psi rise in rear car brake pipe pressure verifies that brake pipe continuity exists.

CN points out,[12] in this respect, that once the release cycle has been initiated the brake pipe pressure rises very rapidly by about 10 psi to 15 psi over 5 seconds, making it difficult for an observer of the pressure rise on the RDU to note precisely the pressure at which the observer of the rear car brakes says, by radio, that the brakes have released. Hence, CN argues that the results are predictable due to the timing difficulties.

CN also points out that the current procedure of "*...traditional observations of significant piston movement, complete piston retraction, or*

brake shoes falling clear of the car wheel are all events occurring about 30 to 60 seconds after the release cycle has already started. In this time frame, the brake pipe pressure has long since risen to about 10 to 15 psi.".[13]

CN further discussed the use of a pressure rise criterion to indicate brake release on the rear car by stating:

> *"It might be argued that a 10 psi pressure rise might be an appropriate criterion for the static air brake test to ensure that the brakes have released. Given that a rise over about 2 psi is academic as the release cycle has already commenced and will continue unaided as the brake pipe pressure continues to rise, a 10 psi rise criterion has no foundation in fact".*[14]

Continuing against the possibility of a 10 psi pressure rise criterion, CN explained that:

> *"...some light to moderate brake applications would 'appear' to have not released for many minutes (if ever) due to the time taken to increase the car brake pipe pressure by 10 psi".*[15]

As well, CN states that:

> *"...the use of a 10 psi criterion for the Standing Brake Test and another criterion of 5 psi for enroute brake applications may lead to confusion and would not represent the actual functioning of the car air brake valve".*[16]

Interestingly enough, when considering CN's argument on why the frequency of failing the test criterion is so high, the impression is rightfully gained that the observation of the pressure in the lead locomotive cab would be after the point in time when the brake was actually observed to be released due to the time lag of communicating that the release had been observed. This means that one would expect that the pressure rise recorded would be larger than the rise when the release was actually seen, as the brake pipe pressure would be rising rapidly. One would not, however, have

expected to have recorded pressure rises of 1, 2 or 3 psi, and yet CN recorded 121 instances out of 1,116 tests (10.8%) where the pressure rise was 3 psi or less. Although this has little to do with the test of the use of the Digitair I for brake tests, it certainly does question the accuracy of the transmitted pressures and/or the care with which the tests were performed.[17]

The RTC staff report notes,[18] in this respect, that if the criterion was 10 psi, the number of failures would substantially decrease. More specifically, if the criterion was 10 psi pressure rise, the frequency of rear car brakes not being observed to release would reduce from about 60% (ref. Table 16) to 17%.

Even at 10 psi, however, the test as conceived shows a significant number of incidents when the pressure rise does not represent an actual release of the brakes on the rear car. Nevertheless, CP explained[19] that the brake system is designed to enter the release mode with a brake pipe pressure increase of 1.5 to 2 psi and that in all test cases no brakes failed to release.

The UTU, however, argued that to conduct the No. 2 and 3 air brake tests by an observation of gauges in the locomotive is not reliable as that procedure only indicates that the brakes should have released and does not verify that the brakes have in fact been released.[20]

Test of Pressure Alarms

The Digitair I is designed to provide the crew with a warning: a) when the rear car brake pipe pressure decreases below 45-48 psi; and b) when the rear car brake pipe pressure has been reduced to 0 psi for 5 minutes. The test procedure required the reporting of occurrences when either the low pressure or no air alarms were actuated. The frequency of those occurrences is as follows:

Table 17

OCCURRENCES OF "LO PRESS" AND "NO AIR" ALARMS

CN	CP	CN/CP
15	86	101

Source: Exhibit CTC-1C page 5.

This test is, of course, not a test of the reliability of this alarm feature in the context of whether it functioned properly when it should but rather of when it functions when the air brake system is not adequately charged.

In this respect, CN noted that in one incident the RDU had been incorrectly wired and that two other occurrences had no reported comments.[21]

CP stated that such occurrences have to do with the function of the air brake system, and any occurrence of low pressure or no air being displayed is evidence that the equipment is functioning as intended and is not evidence of a failure.[22]

Distance Measuring Device Accuracy

Based on the average slack action per car, a test criterion for failure of the distance measuring device was set by RTC, in consultation with the railways and UTU, at 30 feet per 1000 feet of train or 3%. In this respect, the following was reported:

Table 18

FREQUENCY OF FAILURE OF THE DISTANCE MEASURING DEVICE

	RTC(1)	CN(2)	CP(3)	CN/CP
-Number of Measurements	N/T	5750	7848	13598
-Number Not Within 2%	2172	N/T	N/T	N/T
-Number Not Within 3%	N/T	514	N/T	N/T
-Number Not Within 4%	728	N/T	N/T	N/T
-Number Not Within 50 feet	N/T	2460	3139	5599
-Number Not Within 100 feet	N/T	1154	1256	2410
-Number Not Within 150 feet	N/T	686	471	1157
-Number Not Within 200 feet	N/T	395	N/T	N/T
-Number Not Within 250 feet	N/T	206	N/T	N/T

(1) Source: Exhibit CTC-1C, Page 8.

(2) Source: Exhibit CN-8, Page 144.

(3) Source: Exhibit CP-16, Page 4.

Note: N/T means not taken or measured under set criteria.

CN points out that one of the reasons for inaccuracies in the distance measuring device in Digitair I is due to "*low frequency noise*" caused by a "*...slight misalignment due to tolerances of the coupling between the axle generator and the locomotive axle*". The signal filtering characteristics of Digitair I were such that this electronic "*noise*" caused greater distance to be measured than was actually traversed. This was adjusted by modifying the filtering characteristics prior to January 1986 tests.[23]

CP stated that the earlier tests of the DMD were not true tests of its accuracy since the time lapse between end-to-end radio communications and the deactivation of the DMD accounts for a large number of the differences between distance moved and DMD measurement. Later tests carried out by CP

were conducted over a pre-measured mile and involved only a head end supervisor with results improving from 61% to 90% within 50 feet, from 84% to 98% within 100 feet and from 93% to 99% within 150 feet.[24]

Direction and Motion Indicator

During the test period, the direction and motion indicator failed a relatively small percentage of the time as seen below:

Table 19

NUMBER OF
DIRECTION AND MOTION INDICATOR FAILURES

CN	CP	CN/CP
76	22	98

Source: Exhibit CTC-1C page 5.

CN commented that certain failures were due to unsatisfactory buff/draft indications — a feature that will not be on Digitair II, and most failures were due to a "*...temporary anomaly of slowness to react prior to display of the correct indication*".[25]

Marker Light Tests

The frequency of failure of the ETIS marker light during the test period was reported as follows:

Table 20

NUMBER OF MARKER LIGHT FAILURES

CN	CP	CN/CP
90	115	205

Source: Exhibit CTC 1-C page 5.

CN pointed out that it felt only four marker light assemblies were responsible for only five exceptions in 1,224 conductor starts and that many of the exceptions were due to caboose inspection light effects on the marker light photo sensor. As well, a number included normal battery change-outs as exceptions. Other exceptions were felt by CN to be normal or explainable.[26]

CP stated that they felt that there were only 17 marker light failures in about 5,231 hours of night time operation and that the reliability rate of seeing both the marker light and a reflective marker was 99%.[27]

Battery Life Tests

Battery status reports were taken on the telemetry battery. During the test period the following results were recorded:

Table 21

NUMBER OF
BATTERY INDICATIONS

CN	CP	CN/CP
13	19	32

Source: Exhibit CTC 1-C page 5.

Nevertheless, it should be noted here that there were no battery failures on CN and that the indications included only two weak battery reports, eight regular changeouts and three unspecified events.[28]

CP pointed out that the batteries operated in all types of weather and temperature ranges from 31°C to -41°C.[29]

Radio Transmissions Tests

Records were kept of "no communication" alarms as follows:

Table 22

NUMBER OF
NO COMMUNICATION ALARMS*

CN	CP	CN/CP
98	132	230

*Failure to receive three consecutive signals.

Source: Exhibit CTC 1-C page 5

CP pointed out that about 88% of all incidents occurred in tunnels and rock cuts; the others were due to either corrupted signals or faulty antennae. CP also argued that close to half of the incidents of no communication occurred in the Connaught tunnel.[30]

Coding and Identification Systems Tests

Frequency of alarms related to coding and identification systems on Digitair I were recorded as follows:

Table 23

CODING AND IDENTIFICATION ALARM FREQUENCY

	CN	CP	CN/CP
No. of Alarms	2	10	12

Source: Exhibit CTC 1-C, Page 5.

Rear of Train Emergency Feature Test

The test results on the Digitair II system rear of train emergency feature were distributed on March 9, 1987 to all parties. This feature was not available for testing until the Fall of 1986 as that was the first time the manufacturer had Digitair II available as a production type model.

The emergency feature was only tested while the train was static since to test in motion would be unnecessarily hazardous.

Table 24

REAR OF TRAIN EMERGENCY FEATURE TEST

	CN	CP	CN/CP
No. of Tests	295	638	933
No. of Failures	1	4*	5
% of Failures	0.34	0.63	0.54

*Note: Two failures were counted on the same form when an emergency occurred but the IDU did not display 0 psi even though the emergency occurred.

Source: Exhibit CTC 1-i, Page 3.

The radio continuity feature was also tested en route while in motion. The results follow:

Table 25

CONTINUITY TEST

	CN	CP	CN/CP
No. of Tests	373	939	1312
No. of Failures	2	1*	3
% of Failures	0.54	0.11	0.23

*Also 8 temporary problems in rock cut areas.

Source: Exhibit CTC 1-i, Page 3.

End-of-Train Device Installation Test

During this test RTC officers observed the installation of the end-of-train units by railway personnel to determine the frequency of safety-related incidents.

There were no incidents reported during these tests except that in one situation there was a delay. Therefore, it doesn't seem that there would be any safety-related problems that would occur during the installation of the end-of-train units.

3.5 Rear Train Crew Survey

General

The objective of the rear train crew survey was to determine the frequency of safety-related incidents that would go unnoticed or unchecked on a cabooseless train equipped with an ETIS and the rear crew located in the locomotive cab.

A survey of the rear train crew was made: a) during the conduct of Test No. 1 on the ETIS performance on test trains, and b) during a separate test period of 19 randomly selected days over 6 months on every train on CN and CP. The survey was conducted in a way so as to obtain returns only where there were exceptions. Often more than one exception occurred on one rear crew shift.

Herein only the general train survey results or Test No. 3 results, which were made public on September 10, 1986, will be considered. This is because Test No. 3 was a survey of all trains for select but random days rather than on a few selected test trains. As well, the general train crew survey involved over 28,000 crew starts compared to 3,200 crew starts for Test No. 1. In the Panel's opinion, the general train crew survey is considered more representative.

Test Details

The following facts are relevant to describing the extent of the general train survey:

a) Test Periods: There were three test periods within which survey days were randomly chosen as follows:
   - 5 days between November 10 and December 14, 1985
   - 7 days between January 12 and March 31, 1986
   - 7 days between April 1 and June 7, 1986.

b) Sample Size: All crew starts on every train were surveyed for each test day chosen.

c) Control: All conductors had to conform to the survey form in reporting exceptions, but that form in no way restricted the conductor's ability to identify incidents. Provision was also made on the form for railway officers to comment.

d) Assessment: Forms were distributed and collected by the railways for the RTC and copied to the UTU.

e) Data Rationalization: RTC made numerous attempts with both the railways and the UTU to resolve apparent discrepancies in the interpretation of respondent comments on the survey forms.

f) Data Categorization: RTC categorized the responses into 29 incident types for ease of analysis.

The UTU determined the following data, which places the test environment into a different context:

Mean test miles/crew start	128 miles
Mean test tons/train	5,609 tons
Mean test train length	4,998 feet
Mean test cars/train	77 cars

Test Significance

Data relevant to the significance of the test survey is found in Table 26. Several important facts can be determined from this data. According to RTC staff records, during the 6 month test period, which spanned most climatic changes, an average of 1,562 potential reports existed per test day for a total of 29,681.[31] The actual total number of reports submitted based on exceptions were less, namely 2,716. Of these, 1,114 were considered by RTC staff to be valid. This amounted to about 1 valid report per 26.6 crew starts. Perhaps more significantly, over the total test period, there was a marked decline in reports with incidents relative to the number of crew starts where reports could potentially be made. It is the Panel's opinion that three major possibilities exist for this decline: a) a decline in incidents due to climatic/seasonal changes; b) a growing apathy on the part of rear crew in completing the forms; or c) a reduction in reports on trivial or insignificant incidents with time. Table 27 exemplifies this trend in terms of reports with incidents per 1000 crew starts surveyed which average 106 per day for CN and 76 per day for CP.

Table 26

TRENDS IN CREW STARTS AND SURVEY REPORT FREQUENCY

Test Day	Date	CN		CP	
		Starts	Reports*	Starts	Reports
1	Nov. 27	868	172	694	119
2	Nov. 29	882	205	746	95
3	Dec. 2	835	153	682	75
4	Dec. 3	873	152	719	87
5	Dec. 12	970	120	735	78
6	Feb. 1	763	110	596	49
7	Feb. 4	831	98	671	53
8	Feb. 9	509	62	542	50
9	Mar. 6	913	71	724	60
10	Mar. 12	943	82	724	44
11	Mar. 17	877	55	638	59
12	Mar. 21	962	65	696	43
13	April 13	732	47	555	30
14	April 28	894	54	671	31
15	April 30	1,006	61	741	23
16	May 2	1,026	57	778	26
17	May 6	951	59	708	25
18	May 29	1,019	49	717	17
19	June 7	856	61	634	20
	Total	16,710	1,732	12,971	984**

*Reports with incidents
** CP reported 983 (Exhibit CP-16, table N)

Source: Exhibit CTC 1-D

Table 27

REPORT FREQUENCY
(NO. PER 1000 CREW STARTS)

Test Day	CN	CP	Test Day	CN	CP
1	198	171	11	63	92
2	232	127	12	68	62
3	183	110	13	64	54
4	174	121	14	60	46
5	124	106	15	61	31
6	144	82	16	56	33
7	117	79	17	62	35
8	122	92	18	48	24
9	78	83	19	71	32
10	87	61		106	76

Source: Previous table.

From this it can be seen that CN consistently experienced a significantly greater rate of safety-related incidents than did CP. As well, the decline in incident frequency can easily be seen over the 19 test days.

The UTU maintained that a proper survey would have been daily tests of all trains over a period of six months rather than a randomly selected number of test days with only 19 days between November 27 and June 7.[32] The Panel notes, quite apart from the mammoth workload for all parties, the statistics showed a marked decline in incident frequency reported.

Incident Categories

Each of 2,716 reports that noted incidents were evaluated by RTC staff so as to categorize incidents and to determine frequency of occurrence of those incident types. This required considerable judgement in many cases due to the sometimes vague and incomplete description of circumstances surrounding the subject incidents. This later turned out to be one reason

why analytical discrepancies arose between RTC, UTU, CN and CP evaluations of the same survey forms.

The categories of incidents chosen for the analysis are described below:

Table 28

GENERAL SURVEY INCIDENT CATEGORIES

1. Detection of hot boxes or dragging equipment not detected by wayside equipment.
2. Detection of sticking brakes.
3. Detection of leaking cars or containers containing dangerous commodities.
4. Detection of mechanical defects on cars not detected during terminal standing or pull-by inspection.
5. Train struck vehicle at road crossing at grade.
6. Detection of shifted or protruding loads and loose strapping or bracing material not detected at terminals during standing or pull-by inspection.
7. Broken rails, sun kinks, washouts or other damage to the track and structure.
8. Fires on or adjacent to the right-of-way.
9. Spring switches which do not return to normal position after a train has trailed through.
10. Instances of improper or non-placarding of dangerous commodity shipments not detected at initial terminal.
11. Improper marshalling of cars in trains not detected at initial terminal.
12. Instances of delay in cutting crossings and compliance with UCOR 103 Paragraph 3.
13. Instances where trains had to be cut at crossings to permit the passage of emergency vehicles.
14. Instances where trains are disabled or stopped by emergency application of the brakes where UCOR 102 requires protection on adjacent tracks.

15. Instances where trains had to be operated in reverse for long distances and where difficulty is experienced applying Paragraphs 1 and 2 of UCOR 103.

16. Incidents where rear crew provided assistance to accident victims where the same assistance could not have been provided by head end personnel or other witnesses.

17. Vehicle struck the side of the train at road crossing at grade.

18. Loss of braking capability at head end where rear crew had to apply brakes in emergency (to avoid an accident).

19. Incidents where the front ETIS unit registers the appropriate decrease and increase in brake pipe pressure during a No. 2 brake test but where the rear car brake shoes are observed not to apply and release as required.

20. Observance of dangerous conditions on passing trains.

21. Visual signals received from the public or employees where it was not possible to communicate by radio when necessary to stop train or report a dangerous condition.

22. Use of radio in caboose when all head end radios have failed.

23. Engine failure during inclement weather resulting in the caboose being the only adequate shelter.

24. Observation of special cars placed in close proximity to the caboose (specify location).

25. Instances where trains came apart on bridges without walkways and where there is a need to apply hand brakes on the rear portion of the train and this cannot be accomplished by the head end crew.

26. Other incidents not listed above or in Categories No. 27, 28, 29.

27. Hot box and dragging equipment detectors inoperative or failure.

28. Radio defects or failures.

29. Brake pipe pressure air continuity problems.

30. Other incidents not listed above and invalid due to:

    a) not first detected by rear crew, or
    b) not a safety-related incident.

Source: Exhibit CTC-1D Appendix B

Incident Frequency

The RTC analyses show that not all categories were identified in the survey as having occurred.[33] This, of course, does not mean that there is no possibility of their occurrence but rather that the chance of their occurrence is less than those rated as incidents during this survey.

The frequency of occurrence of the categorized incidents is displayed in the following table, according to RTC staff analyses.

Table 29

GENERAL TRAIN SURVEY
CTC ANALYSIS OF
FREQUENCY OF OCCURRENCE OF INCIDENT CATEGORIES

Category	CN	CP	CN/CP	Category	CN	CP	CN/CP
1.	4	5	9	16.	3	-	3
2.	152	21	173	17.	1	-	1
3.	-	-	-	18.	1	-	1
4.	4	5	9	19.	-	-	-
5.	1	-	1	20.	31	4	35
6.	28	16	44	21.	2	-	2
7.	12	13	25	22.	2	1	3
8.	2	2	4	23.	1	-	1
9.	53	3	56	24.	2	3	5
10.	-	-	-	25.	1	-	1
11.	-	-	-	26.	113	236	349
12.	14	4	18	27.	28	52	80
13.	1	1	2	28.	64	43	107
14.	19	4	23	29.	44	10	54
15.	65	7	72				

Source: Exhibit CTC 1-D page 22.
(See fold-out Appendix 6 for descriptions of categories.)

Data Discrepancies

As noted earlier, there were a number of discrepancies between the frequency of incident occurrence data as evaluated by the separate parties to this case. Table 30 conveys this discrepancy.

Considering the size of the survey and the "free-form" response it afforded respondents, as well as the degree of opinion/judgement required to classify the responses, the Panel believes the similarity of results of the different parties is actually quite astounding. Nevertheless, differences have been noted and were the subject of long and hard debate during the hearing. As will be seen later, however, the Panel is of the opinion that the survey results are best used to determine the ranking of frequency of occurrence rather than the forecasting of the frequency of occurrence of safety-related incidents. In this respect, the discrepancies between different parties as to the actual frequency of occurrence during the test period is not all that significant.

Table 30

INCIDENT FREQUENCY DISCREPANCIES

Category	CN (UTU***)	CN (RTC)	CN (CN*)	CP (UTU)	CP (RTC)	CP (CP**)	TOTAL (UTU)	TOTAL (RTC)	TOTAL (CN*/CP**)
1	5	4	0	10	5	6	15	9	6
2	185	152	162	27	21	22	212	173	184
3	0	0	0	0	0	0	0	0	0
4	3	4	2	7	5	11	10	9	13
5	-	1	0	-	0	0	-	1	0
6	25	28	24	16	16	16	41	44	40
7	17	12	7	25	13	27	42	25	34
8	2	2	0	1	2	2	3	4	2
9	44	53	48	1	3	0	45	56	48
10	-	0	0	-	0	0	-	0	0
11	-	0	0	-	0	1	-	0	0
12	17	14	19	6	4	6	23	18	25
13	1	1	1	0	1	0	1	2	1
14	21	19	26	4	4	3	25	23	29
15	102(1)	65	76	21	7	18	122	72	94
16	2	3	0	0	0	0	2	3	0
17	1	1	1	0	0	0	1	1	1
18	1	1	0	0	0	0	1	1	0
19	-	0	0	-	0	0	-	0	0
20	47	31	38	8	4	4	55	35	42
21	6	2	2	1	0	0	7	2	2
22	4	2	1	5	1	1	9	3	2
23	1	1	1	0	0	0	1	1	1
24	5	2	4	4	3	4	9	5	8
25	2	1	2	0	0	0	2	1	2
26	-	113	102	-	236	42	-	349	144
27	46	28	49	72	52	85	118	80	134
28	-	64	69	-	43	20	-	107	89
29	-	44	64	-	10	18	-	54	82

*Source: Exhibit CN-9 page 80
**Source: Exhibit CP-16 page 19
***Source: Exhibit CRLA-UTU 112 page 91

(1)Reverse move of one mile or more
(See fold-out Appendix 6 for category description.)

Category Ranking

The foregoing provides the basis to rank the various safety-related incidents in accordance with decreasing chance of occurrence. Such a ranking coincidentally eliminates the discrepancies in the detailed frequency data in Table 30.

Table 31

RANKING OF SAFETY-RELATED INCIDENTS

(decreasing chance of occurrence)

Occurrence Frequency Range*	Safety-Related Incident Category
150 - 200	2
75 - 150	15,27, 28
50 - 75	9,29
35 - 50	6,20
20 - 35	7,12,14
5 - 20	1,4,24
less than 5	3,5,8,10,11,13,16,17,18, 19,21,22,23,25,

* No. in 19 test days
(See fold-out Appendix 6 for category description.)

Although the ranking by test frequency range is not rigorously accurate, it is a ranking that logically assists in considering the significance of the risks associated with each categorized safety-related incident. Detailed discussion of each incident type in accordance with this rating will follow.

Detection of Sticking Brakes (CATEGORY 2)

The detection of sticking brakes by the rear crew was the most frequent "safety-related" incident observed in the general train survey, that is roughly 173 to 184 times in 19 days.

CN explained that there are normally many ways and locations where sticking brakes can be detected, namely:

- by equipment employees on inbound yard tracks;
- by yard or train crew when marshalling;
- during brake tests;
- at pull-by inspections;
- by hot box and dragging equipment detectors;
- by head end crew;
- by passing train crew; and
- by wayside observers[34]

In argument, CN explained that *"a prolonged brake application on a heavy tonnage train creates a similar condition which is within the realm of normal operating conditions"*.[35] Although this is true, that does not negate the reality of the frequency of occurrence of sticking brakes first noted by the rear train crew during the tests even with all of those *"after opportunities"* to detect the same sticking brakes. Conversely, the first observation of sticking brakes by the rear crew does not mean that subsequent observation by other than the rear crew at other locations would not quickly have resulted in the identification of those same incidents of sticking brakes prior to any serious damage to the wheels.

CN also pointed out that *"...many forms have been annotated.... that release was obtained by requesting a heavier brake application.... followed by a normal release"* rather than to cut out the brake system of the affected car or cars.[36] This method of resolving the problem of sticking brakes does not negate the fact that only a limited number of cars can be seen from the rear of the train in transit. Nevertheless, if the rear train

crew is placed in the locomotive cab, identification of sticking brakes on those cars that are close to the rear of the train would definitely not be possible. Furthermore it appears that, if a heavier brake application with a normal release occurred after the sticking brake occurred, it may be resolved and therefore observation of a sticking brake at a particular point in time may not be all that critical.

CN implied that sticking brakes can result from poor train air brake handling associated with minimum brake applications as well as from defective car brake equipment. In this respect, CN pointed out that 90% of the cars reported to have sticking brakes had no defects and 4% had probable defects related to sticking brakes.[37] In this respect, CN also argued that the ETIS monitors train brake pipe pressure thereby indicating to the locomotive engineer conditions which may create sticking brakes.[38]

One of the most serious repercussions of sticking brakes is wheel damage resulting from overheating of the wheel. CN gave testimony to the fact that the heat input from a brake shoe applied to a wheel surface increases with the brake shoe force and with train speed.[39]

Although the heat input rate of a sticking brake is relatively low, thermal damage to wheels is also dependent on the duration of the heat application. The longer a sticking brake goes without observation, the greater the chance of wheel damage and derailment.

Other results of sticking brakes can include wheelwear, brake shoe wear, brake rigging wear, and increased fuel consumption — all of which increase costs but which are not necessarily causes of derailments.

The UTU noted the frequency with which sticking brakes were detected by a hot box detector during the 19 day test period — that being 64, or slightly more than one third of the times the UTU noted sticking brakes detected by the rear crew.[40]

CN finally argued that "*... a sticking brake is not a symptom of impending derailment and can be detected by so many other means that the issue of how it was first detected is academic*".[41]

CP also held that sticking brakes do not normally constitute any potential safety hazard except where the wheel is locked in place — a very unusual situation.[42] In this respect, CP pointed out that the British Columbia Caboose Committee witness, Mr. Martin, stated that it is normal operating procedure to "drag" the brakes at a 10 psi brake reduction for 12-13 miles on the heavy grades in the Fording River Subdivision.[43]

In a cabooseless operation, CP pointed out that sticking brakes will be detected by hot wheel detectors, other train crews, other employees, and the head end crew of the train.[44]

Long Distance Reverse Train Movements (CATEGORY 15)

The frequency of occurrence of long distance reverse train movements, when difficulty was experienced in applying paragraphs 1 and 2 of UCOR 103, was relatively high at 72 to 94 times in 19 days.

CN points out that in cabooseless operations a train crew member would protect the leading car of the movement under UCOR 103 with radio being used in adherence to Section 3.3(2), CN Form 696. Alternatively, locomotives could be run around the train.[45] CN implies that there would not be any change in the level of safety or the risk of reverse movements.

The UTU noted 356 reverse movements into yard tracks or short reverse movements not noted under the No. 15 test category, or roughly 3 times the number of reverse movements reported by the UTU under category no. 15.[46] (102 reported on CN.)

CP explained that the reverse moves reported "*.... ranged from normal operating practices on road switcher assignments to backing out of sidings because of frozen switches, to those made solely for crew convenience at hot-box detector stops*". Most reverse moves were no longer than one train length. CP argued that "*... where it is normal operating practice to make a lengthy reverse move we would make alternate arrangements .... in cases of reverse moves, solely for crew convenience, Mr. Chairman, the crew would walk*".[47]

Inoperative Hot Box and Dragging Equipment Detector (CATEGORY 27)

One of the mainstays of the railways' position is that hot box and dragging equipment detectors (HBDE) reduce the need for rear end train crew to be located in a caboose. It is therefore important that the frequency of the crew first observing inoperative HBDE is relatively high at 80 to 134 times in 19 days.

CN stated that the vast majority of incidents of inoperative HBDE were known in advance — prior to being observed by the rear crew.[48]

With the use of "talkers" the problem identified here ceases to be a problem, according to CN.

CN nevertheless argued that HBDE are in service 99.6% of the time based on a summary of detector outages for the period January 1, 1985 to October 31, 1986. They further pointed out that of 22 confirmed hot boxes during the general train survey, none were first detected by CN rear crew members.[49]

The UTU contended that HBDE required almost daily or weekly attention based on CN's HBDE service calls report for January 1, 1985 to October 31, 1986.[50]

Radio defects (CATEGORY 28)

The frequency of radio defects or failures first noted by the rear crew is similar to that of inoperative HBDE and reverse train movements ranging from 89 to 107 times in 19 days.

CN argued that "... *the re-deployment of the rear crew to the head-end will eliminate communication interruptions between the locomotive engineer and the conductor and also reduce radio congestion. As well, locating the conductor's portable radio with dispatcher tone calling feature in the leading locomotive, will provide immediate backup to the locomotive radio*".[51]

Spring Switch Fault (CATEGORY 9)

The frequency of the rear crew observing spring switches not returning to the normal position after the train has trailed through is relatively high at 48 to 56 in 19 days.

Being most predominant in winter due to snow and ice, a spring switch fault poses a danger to trains operating in the facing point direction unless the track is signalled.

CN explained that all spring switches on CN are protected by a signal system requiring a permissive indication before being passed over.[52]

CN further argued that "... *the provisions of UCOR 104A paragraphs 2 and 3 apply when making a facing point movement, and the presence or absence of a caboose will have no bearing on operational safety relative to spring switches*".[53]

CP noted that no such incidents occurred on CP and that the number of spring switches on CP is very small and in all cases are protected by signals.[54]

Brake Pipe Pressure Air Continuity Problems (CATEGORY 29)

Brake pipe pressure air continuity problems were first observed by the rear crew 54 to 82 times in 19 days — a relatively frequent event compared to the frequency of other incidents.

Upon investigation, the RTC found that most of the instances noted involved a situation where cars had been set off with the angle cock, behind the last car cut off, closed and the brake pipe on the remaining cars vented as per railway operating instructions. In cabooseless situations, the ETIS would register zero pressure to the rear with positive pressure on the head end of the train — exactly what should be expected.

CN concluded, that "*... the majority of air continuity events occurred during cold weather operation. Operating crews took the appropriate steps to reduce train length, or made repairs which allowed the trains to proceed*".[55]

Shifted or Protruded Loads and Loose Strapping (CATEGORY 6)

The frequency of rear crew observing shifted or protruding loads and loose strapping not detected at terminals during standing or pull-by inspections was 40 to 44 times in 19 days.

The majority of incidents under this category involved loose or dragging strapping, open doors, dunnage, tarpaulins or chains. CN pointed out that these faults would be subsequently found on pull-by meets or during yard inspections. Even so, they would continue to exist until next discovered. CN also pointed out that its records show no derailments or personal injuries have occurred from this cause.[56] CP agreed that such defects are detected during pull-by or standing inspection by other crew or other employees.[57]

Mr. McDiarmid explained that shifted load detectors on U.S. railways are for protecting bridges and structures; not something

arising from or as a result of cabooseless operations.[58] As well, CP pointed out that shifted load detectors are not an FRA requirement for cabooseless operations in the United States.[59]

Dangerous Conditions on Passing Trains (CATEGORY 20)

The observance of dangerous conditions on passing trains first noted by the rear crew occurred 35 to 42 times in 19 days.

Although CN pointed out that, in cabooseless operations, the crew in the locomotive cab will observe passing trains and, in the case of a standing train, will take up a position on either side of the passing train so as to inspect it, the occurrence of these observations were not seen by the front end crew of the subject trains.[60] CN further argued that the locomotive headlight will especially be of assistance under these conditions during darkness or poor visibility.

CP argued that, in a cabooseless operation, "*... the head end crews will still, at meeting points, be able to discover defects as the train is passing. Detections of conditions will not differ from that which is now done*".[61]

The UTU noted that the number of times dangerous conditions were detected by crew other than the rear crew was 13 times in 19 days, compared to 55 times recorded by UTU for dangerous conditions detected by all crews.[62]

Broken Rails, Sun Kinks, Washouts or other Damage to the Track and Structure (CATEGORY 7)

Track and structure damage is a cause of derailments. In 1985/86 derailments on CN and CP due to track related problems number 109 and 56 respectively.

During the test period the rear crew first observed track damage 25 to 34 times in 19 days.

CN pointed out that such damage is normally detected by track maintenance forces. Bonded trackage with broken track results in signal protection and in CTC dispatcher notification. Theoretically, front end crew also have an advantageous position to observe such damage.[63]

CN further explained in argument that, of the 11 incidents on CN, 7 concerned rough spots or dips in the track which were a result of shimming in 4 cases, a minor low rail joint in two instances and a rough crossing — none of which CN considered unsafe. Of the four remaining incidents, one involved a sun kink and three concerned broken rails, one of which was found at a terminal and the others were breaks of three and two inches respectively. In all cases the entire train passed over the defects without incident.[64]

It is clear that rear crews are not capable of detecting the type of track defects that the Sperry rail cars detect, as testified to by Mr. Hone of the UTU.[65]

Furthermore, CN testified that detection is usually achieved by crew members on the locomotive.[66]

From the above, derailments due to undetected track damage do occur even with the check mechanisms in place and rear end crew can discover track damage not otherwise discovered at a particular point in time.

Delay in Cutting Crossings and Compliance with UCOR 103 Paragraph 3 (CATEGORY 12)

Delays in cutting crossings and compliance with UCOR 103 paragraph 3 occurred 18 to 25 times in 19 days.

CN pointed out that there would be no change to the present requirement of cutting crossings in a cabooseless operation. An employee in the locomotive cab would detrain at the crossing as the train passes and be governed by Rule 103. In terms of clearing a crossing for an emergency vehicle, CN believes the cabooseless operation "*...will better serve the need than the present practice, which often requires a rear-end employee to walk*

to the crossing after the train stops". CN also suggested that "*...holding back prior to occupying a crossing at a meet, or marshalling the train and holding onto a number of cars to ensure clearance when lifting or setting off, are other means of complying with the rule*".[67]

CP argued that trains could be cut from the head end but that, in the event of an emergency stop, the problem which created the emergency must be rectified before any cut can be made. In a cabooseless operation, CP would ensure for pre-planned stops so that the stop will be at a location where no crossing is blocked or that an employee is dropped off to make the cut.[68]

Instances Where UCOR 102 Requires Protection on Adjacent Tracks (CATEGORY 14)

Instances when trains were disabled or stopped by emergency applications of brakes where UCOR 102 requires protection on adjacent tracks occurred 23 to 29 times in 19 days.

CN pointed out that it intends to employ an operating instruction which precludes cabooseless trains from being passed in motion on two or more track territory; the situation will be protected by the train dispatcher for CN trackage. CN would also make arrangements with other railways to ensure that protection for the rear of cabooseless trains will be provided at the few isolated locations where they will be operated adjacent to their tracks.[69]

CP explained that, in cabooseless operations, "*...a radio procedure almost identical to that used by U.S. railways and BC Rail for protection under Rule 102...*" shall be used. CP feels that this emergency radio procedure, to obtain relief from flag protection from the dispatcher, is more expedient than flagging. As well, the radio procedure will alert all trains in the vicinity of the distress situation and they would have to come to a stop before arriving at the location of the distress.[70]

The UTU noted 132 incidents during the survey period when trains were disabled or stopped by emergency application of brakes and rear crew affects repairs and Rule 102 protection is not indicated compared to the 25 times UTU recorded when Rule 102 protection was required for adjacent tracks.[71]

Detection of Hot Boxes or Dragging Equipment Not Detected by Wayside Equipment (CATEGORY 1)

Hot boxes or dragging equipment were detected by rear crew 6 to 9 times in 19 days when same were not detected by functional wayside equipment.

The UTU noted 13 hot boxes or dragging equipment detected by HBDE during the 19 day test period. This was compared by the UTU to the 15 times when the rear crew detected a hot box or dragging equipment.[72]

CN argued that there were no such incidents on CN during the test period and that the rear crew rarely detect a hot box or dragging equipment before those defects are detected by wayside equipment. As an example, CN stated that none of the 22 hot boxes that occurred on CN during the test period were first detected by members of the rear crew.[73]

Detection of Mechanical Defects on Cars Not Detected During Terminal Standing or Pull-By Inspection (CATEGORY 4)

Mechanical defects on cars not detected during terminal standing or pull-by inspection were detected by rear train crew 9 to 13 times in 19 days.

On CN, the defects included an air leak and a wheel with a flat spot. CN argues that such defects would/could be detected in the normal course of inspections by front crews, pull-by inspection, wayside observers, etc., and therefore the presence of rear crew is not critical to the detection of such defects.[74]

CP argued that none of the incidents of this type reported on CP posed any immediate hazard to the safe movement of the train and included matters such as leaking hose-bag gaskets, missing brake shoes, and loose

ladders — all things that would be detected subsequently by other train crews, other employees, head end crews or by hotbox and dragging equipment wayside detectors.[75]

Observation of Special Cars Placed in Close Proximity to the Caboose (CATEGORY 24)

Special cars that require close observation such as extreme dimensional loads were placed in close proximity to the caboose in 5 to 8 situations in 19 days.

CN argued that specialty cars that require close observation in cabooseless operations "... *will, when practicable, be placed closely adjacent to the locomotive consist to allow observation by head-end crew members. Those cars that are restricted or cannot be accommodated at the head-end because of design, regulation or otherwise, may well have to be moved on special trains*".[76]

Mr. Leslie of CP Rail testified in this respect that "...*I do not see any reason why special cars could not — cars requiring special attention could not always be put up near the head-end*".[77]

Fires on or Adjacent to the Right-of-Way (CATEGORY 8)

Rear crew first observed fires on or adjacent to the right-of-way 2 to 4 times in 19 days.

CN claimed most incidents were of controlled fires unrelated to train operation.[78] CP pointed out that one incident reported on CP should not have been reported as it was a controlled burning of ties by section men.[79]

CP also explained that uncontrolled fires would be detected by employees other than rear crew and the public in a cabooseless operation and that track patrols are usually increased in remote areas when weather conditions result in a high risk of fire situations.[80] However, the UTU

claimed that many more instances would have been reported had tests been conducted in July to September.

Instances where Train had to be cut at Crossings to Permit Passage of Emergency Vehicles (CATEGORY 13)

Rear crew reported instances where trains had to be cut at crossings to permit passage of emergency vehicles 1 to 2 times in 19 days.

In the one case reported on CN, an ambulance was at the scene due to a train striking an automobile on a crossing. CN explained that in a cabooseless operation *"trains can be held back at meeting points clear of public crossings. If necessary the crossing will be cut by detraining a head-end employee as the train passes the location."*[81]

CP argued that *"...full compliance with UCOR Rule 103 would make this a non-event"*.[82]

Use of Radio in Caboose when all Head End Radios have Failed (CATEGORY 22)

The rear crew reported the use of radio in their caboose when all head end radios failed 2 to 3 times in 19 days.

CN explained that in the one case reported by them the portable head end radio was available and could have been used.[83] Furthermore, they argued that the conductor's five-watt portable radio, equipped with dispatcher tone-calling feature, enhances communications reliability and avoids communication interruptions and congestion.

CP testified that *"...in cabooseless operation, a train would have, as a minimum, at least three radios, those being the 25-watt engine radio and two 5-watt portables. In addition, each locomotive in the consist is equipped with a 25-watt radio"*.[84]

CP further explained that the 25-watt radio has a 20 to 25 mile range, and the 5-watt a 5 to 10 mile range. CP also has a *"point to train*

radio system" covering all main and secondary main lines and intends, under a cabooseless system, to ensure "each group of employees will be radio-equipped".[85]

Rear Crew Assistance to Accident Victims (CATEGORY 16)

Rear crew reported assisting accident victims up to 3 times during the 19 days. However, neither railway felt this occurred.

For those cases reported to RTC, medical supplies such as blankets and a stretcher from the caboose were used; however, the railways claim such supplies would be available on the cab.

CN argued that the best solution to such problems is prevention through support of Operation Lifesaver and educational programs.[86]

Train Struck Vehicle at Road Crossing at Grade (CATEGORY 5)

This event is recorded as having occurred once in 19 days of survey by RTC. The railways deny this as having occurred.

CN pointed out that 80% of crossing accidents occur within the first 10 cars of a train[87] and that *"The presence or absence of a caboose has no bearing on the detection of such accidents"*.[88]

The UTU recorded 2 occurrences on CN where the rear crew apparently prevented a train from striking a vehicle at a road crossing at grade.[89]

CP pointed out that 77.2% of crossing accidents involve trains striking vehicles, (based on a survey of accidents from January 1, 1980 to June 30, 1986), and that in such cases the front end crew would be the first to notice.[90]

Engine Failure During Inclement Weather Resulting in the Caboose being the Only Adequate Shelter (CATEGORY 23)

This occurred once in 19 days and, in that one case, the front crew chose to occupy the caboose until a supplementary unit was supplied to replace the single locomotive unit on the subject train.

CN is of the opinion that the initial warmth of the locomotive cab is sufficient protection given the time necessary for unit replacement after calling the dispatcher by radio.[91]

CP explained that a situation with a single unit train in a territory with no housing with that unit failing is a very remote possibility. A majority of CP trains are multiple units. There is also a requirement on CP that crews be properly dressed for the environment in which they may have to operate, similar to roadmasters on patrol.[92]

Vehicle Struck the Side of the Train at Road Crossing at Grade (CATEGORY 17)

A vehicle striking the side of a train occurred once in 19 days. In this situation, the impact due to vehicle brake failure was to the 33rd car of a 39 car standing train. No injuries occurred.

CN explained that the front crew would supply such medical assistance "... *within the parameter of their expertise, willingness and capability to effect relief or aid...*" but the primary responsibility of crew members is to report the accident and request medical assistance.

CN also argued "...*good common sense dictates that anyone who is in the vicinity of someone who is injured would undertake to provide whatever assistance we can provide, whether it be as a motorist or employee on the railway or otherwise. But it is not a situation that, in itself, justifies retaining a caboose and a member of the crew at the rear to fulfill that function*".[93]

CP argued that this type of incident should be placed in the proper context. They explained that between January 1, 1980 and June 30, 1986, there were 387 incidents where a vehicle struck the side of one of their trains; only 22.8% of all crossing accidents in that time period. Of those, 270 struck one of the first 10 cars of the train and 117 occurred behind the tenth car. Of the 117, only 52 were first reported by the rear crew, 2 by the head end crew, and 63 by others. Of the 52 first reported by the rear crew, 10 were found during a standing inspection as a result of an emergency brake application arising from the accident and 4 others were discovered during a reverse move. Yet 4 more were discovered by the rear crew when the train was standing and the noise of the collision was heard.[94]

Loss of Braking Capability at Head End Where Rear Crew Had to Apply Brakes in Emergency to Avoid an Accident (CATEGORY 18)

According to RTC staff, but neither railway, this event occurred once in 19 days.

The incident involved a partly closed angle cock two cars behind the locomotives — a situation which the ETIS would have detected and conveyed to the locomotive engineer, according to railway officials. According to CN,[95] Digitair II will offer the ability to offset this problem since an emergency brake application can be initiated at each end of the train.

CP argued that this type of loss of braking is an extremely rare occurrence. With cabooseless operations, the air brake pipe continuity can consistently be monitored by the locomotive engineer and the locomotive engineer will be able to apply an emergency from the control locomotive, starting at the rear of the train, by using the emergency brake feature incorporated in Digitair II.[96]

Detection of Leaking Cars or Containers Containing Dangerous Commodities (CATEGORY 3)

This did not occur during the survey on either CN or CP.

CN argued that identification of a leak from the vantage point of the caboose of a moving train would be *"most improbable"*.[97] CP explained that such leaks are normally found during a standing or pull-by inspection.[98]

CP argued further that *"...the detection of any leaking commodity is, for the most part, an event which takes place in yards, terminals during pull-by and while the train stopped between terminals"*.[99]

Improper or Non-Placarding of Dangerous Commodity Shipments not Detected at Initial Terminal (CATEGORY 10)

This did not occur on CN or CP during the survey.

The responsibility for correct documentation and placarding originates with the shipper and is verified by rail crews prior to "lifting" this traffic from the shipper's siding. Equipment employees also inspect and ensure proper placarding is in place, prior to departure of outbound trains.[100]

CN testified that an employee who had been suitably trained and equipped to perform a pull-by inspection would take the place of a conductor, for inspection purposes, where the conductor is the only one who would make that inspection.[101]

CN also testified that at crew change-off points where the rear crew now makes a pull-by inspection, the incoming crew would perform that inspection on departure of the train.[102]

CP holds the same view as CN, and commented in argument that if a placard were *"...to go missing en route between terminals, the risk would be no greater with or without a caboose, as the conductor has the consist and emergency response forms in his possession"*.[103]

Improper Marshalling of Cars in Trains not Detected at Initial Terminal (CATEGORY 11)

This did not occur on either CN or CP during the survey.

CN argued that "*...considering alternate detection capabilities, the removal of the caboose and rear crew will not compromise safety*".[104]

CP argued that "*...in cabooseless operations, improperly marshalled trains would be detected during the pull-by inspection and if the train were improperly marshalled after departure, it would be the result of the crew changing the marshalling*". CP also reminded the Panel of its "*...on-line computer program which checks out each train before it departs from its original terminal to ensure that dangerous commodity marshalling requirements are being adhered to*".[105]

Visual Signals Received from the Public or Employees Where it was not Possible to Communicate by Radio when Necessary to Stop Train or Report a Dangerous Condition (CATEGORY 21)

This event occurred twice during the survey on CN, but CN argued that this normally involves notification to the railway by telephone and relay of information by radio to the train.[106]

In one incident, a passerby detected a sticking brake condition and, in the other, a farmer detected a hot box on the eleventh car ahead of the caboose. The farmer informed CN that had his signals to the rear crew not been heeded, he would have called the railway.[107]

CN also explained that "*...it is our intention to equip all of our track maintenance groups with portable radios consistent with cabooseless operations*".[108]

CP echoed this plan "*...to ensure that the maintenance-of-way gang is equipped with a radio which has the end-to-end frequency*".[109]

CN argued that all police departments and fire departments have the railways' local telephone numbers in the event they are informed of problems on a passing train.[110]

The UTU noted that there were 7 incidents where visual signals were received from the public and 14 incidents when signals were received from employees or the public where radio communication was used.[111]

Instances where Trains come Apart on Bridges Without Walkways and Where There is a Need to Apply Hand Brakes in the Rear Portion of the Train and this Cannot be Accomplished by the Head end Crew (CATEGORY 25)

This occurred 1 to 2 times on CN in 19 days.

CN explained that in a cabooseless operation *"Arrangements would be made which could include assistance from a following train, track forces or other train movements. Also, track forces or other employees with highway vehicles could in many cases provide assistance"*.[112]

CP noted that on its system no incidents in this category were reported.

Mr. Gibbon of the CSX Transportation Company testified that his company had not had difficulties of this variety with cabooseless operations and that, if it occurred, crew would be transported to the rear by whatever vehicular means were available.[113]

CP held that the chance of this type of incident occurring is *"...remote to say the least..."*. CP would require the crew to establish the cause and if it was possible, they would turn the angle cock and pull the tail end of the train off the bridge. If it was impossible *"...the dispatcher would make arrangements for necessary assistance to be provided"*.[114]

Instances Where the Front ETIS Unit Registers the Appropriate Decrease and Increase in Brake Pipe Pressure During a No. 2 Brake Test but Where the Rear Car Brake Shoes are Observed not to Apply and Release as Required (CATEGORY 19)

This did not occur on CN nor on CP. CP argued that brake pipe continuity on a cabooseless train would be established through observation of the ETIS display, and that the application and release of the brakes on the rear car of the train would be evidenced by the rise and fall of pressures as shown by the ETIS.

Other Categories

The UTU developed certain subcategories for category 26 incidents and developed records for frequency of occurrence over the test period as follows:

26-01 *"Instances where the rear crew observes crossing gates or lights not returning to normal position after train has passed":* A total of 21 incidents occurred in 19 days. (6 on CN and 15 on CP.)

26-02 *"Steps taken to avoid roll-backs"*: A total of 13 incidents occurred in 19 days. (7 on CN and 6 on CP.)

26.06 *"Instances where a rear crew observes persons other than employees on or near the right-of-way"*: A total of 14 incidents occurred in 19 days. (6 on CN and 8 on CP.)

26.11 *"Instances where the rear crew provides protection for the rear of the train"*: A total of 18 incidents occurred in 19 days. (15 on CN and 3 on CP.)

26.12 *"Signal failure (CTC, ABS)"*: A total of 4 incidents occurred in 19 days. (4 on CN.)

3.6 ETIS Laboratory Tests

Background

A meeting was held on October 17, 1985 with representatives from the RTC, CN, CP, the UTU and the CRLA, during which it was mutually decided to conduct Environmental Laboratory Testing of the Digitair ETIS equipment.

On December 18, 1984, the Association of American Railroads (AAR) Track Train Dynamics Special Task Force on Rear of Train Information and Telemetry Systems had published the 5th revision of a document, "Guidelines, Considerations and Radio Frequency Specification for Train Information Systems". This Special Task Force, composed of representatives from 19 railroads and the AAR, specified certain operating environmental characteristics that should be considered for the testing and acceptance of ETIS equipment. Certain test program parameters, such as test duration and methodology, were not addressed by the Special Task Force document. For instance, the actual range of forces to which an ETIS rear of train unit would be subjected when mounted on the rear coupler of a moving train was not known.

CN, CP, the CRLA, the UTU and DSL concurred with the concept that a test program should follow the AAR "Guidelines". The test parameters were then defined by RTC staff, with technical assistance from Department of National Defence (DND) and National Research Council (NRC) personnel. The AAR Guidelines, as refined, were based on practical experience gained from previous testing of similar products.

Digitair I Tests

Vibration Tests

The sense and transmit unit (STU 05294) and receive and display unit (RDU 3991) in operating mode were subjected to longitudinal, lateral and vertical forced vibration sweeps ranging from 7 H_Z through to 500 H_Z

(cycles/second), at acceleration forces of up to 2.5 times gravitational force (2.5g), and at room temperature for the initial purposes of determining the worst vibration conditions for the Digitair I components.

One incident of a failed securement of the RDU electro-luminescent panel power supply component (U3) occurred during lateral vibration. Following necessary repair, the RDU completed vibration testing satisfactorily without any further incident of failure.

DSL has since strengthened the attachment of the U3 component in order to prevent a possible repetition of this failure.

Altitude Tests

The Digitair I equipment was subjected to conditions simulating an altitude of 12,000 feet for a prescribed period followed by a satisfactory operational test at conditions simulating an altitude of 6,000 feet.

Temperature Tests

Satisfactory periodic performance tests were carried out over a 78 hour cycle at temperatures ranging from +20°C (room temperature) to -40°C and +70°C.

Humidity Tests

Satisfactory periodic performance tests were carried out over a 31 hour cycle ranging between +20°C (room temperature) to +50°C temperatures and 95% relative humidity conditions.

Temperature-Transport/Storage Tests

The test STU and RDU were subjected to a -40°C temperature for 48 hours. At the end of this test the RDU was not functional due to a repeat of the previous failure of the electro-luminescent panel power supply (U3)

having separated from the circuit board. Following repair of the RDU, the test was repeated for 48 hours and both the RDU and STU functioned properly.

Shock Tests

The STU and RDU were subjected to peak 10 g. and 5 g. shocks respectively for 5 shocks per axis, at room temperature, without incident.

Operational Battery Duration Tests

The STU was operated at -38°C with fully charged used batteries and with the RDU at room temperature with a brake pipe pressure of 90 psi — subject to periodic changes by test staff. After 24 hours of operation under these conditions the RDU air pressure readout did not respond to air pressure changes and remained constant at a readout of 68 pounds pressure. The reason for this failure was not determined. However, DSL suggested that one of the possibilities for the failure could have been condensation, which would not occur at the end of a train at that temperature. Under these conditions it was found that the flashing marker light stopped flashing, in one case after 30 hours of operations and in the next case after 28 hours and 23 minutes of operation.

The STU was also operated at room temperature with fully charged batteries and with the RDU at room temperature with the brake pipe pressure at 80 psi — subject to periodic changes by test staff. After 49.5 hours of operation, the flashing marker light failed and the motion and pressure signals remained operative. These tests indicate that fully charged batteries under varying conditions will last between approximately 28 and 50 hours.

Digitair II Tests

The test program developed for the Digitair II system closely paralleled that developed for the Digitair I system.

Temperature Tests

During the temperature test cycle the Digitair II sense and brake unit (SBU) indicated signal transmission failure at about +45°C while the temperature was slowly being increased. Inspection of SBU 80307 by DSL revealed that pin 15 of a socket EPROM U11 on the digital board was broken. It is most probable that this pin broke during the previous periods of vibration testing. Pin 15 is located near the end of the socket and is therefore vulnerable to mishandling during assembly or metallurgical fatigue during vibration. DSL advised that a stronger type of socket was available to preclude future failures of this nature.

Following inspection and repair by DSL, the SBU was subjected to a repeat of the high temperature portion of the cycle commencing at +20°C without further incident.

Cold Soak and Operation Check

During a 48 hour period in a cold soak storage condition, the Digitair II equipment operated satisfactorily. A simulated blockage of the emergency valve exhaust port with frozen snow was difficult to achieve since no natural snow was available. Four blockages of a varied ice and snow density were successfully cleared by the exhausting air. A fifth test which resulted in a blockage of solid ice indicated that a very dense blockage could be cleared. This is important because if a blockage could not be cleared, emergency application of the brakes would not be possible from the rear of the train.

Humidity Test

The Digitair II equipment peformed satisfactorily during all operational checks carried out during a high humidity cycle.

Operational Battery Duration Tests

During this test, carried out with the SBU at -40°C, and the input display unit (IDU) and communications logic unit (CLU) at 0°C, periodic operational checks of the emergency brake feature were satisfactory and other functions such as flashing light, motion and pressure changes also operated satisfactorily.

After 24 hours of operation with the SBU at -40°C the battery weak character "X" appeared on the IDU and after 29.5 hours of operation the SBU battery failed by showing the character "F" on the IDU display.

All Digitair II units operated at 20°C and performed without exception for 48.5 hours at which time the character "X" was displayed by the IDU and, at 51.5 hours, the marker light operation was intermittent. Other operational checks, including the emergency brake function, continued for 95 hours until the battery fail character "F" appeared on the IDU display.

Shock Tests

The Digitair II IDU and CLU were each subjected to five 5 g. shocks per axis with no exception being noted during operational checks following each shock.

The Digitair II SBU was subjected to five 10 g. shocks per axis with no exceptions being noted during operational checks following each shock.

Vibration Tests

The Digitair II IDU, CLU, and SBU were subjected to similar longitudinal, lateral and vertical forced vibrations as those applied to Digitair I, noted previously.

The SBU failed during longitudinal vibration due to pin 40 of socket U17 on the analogue board breaking. Socket U17 was renewed by DSL. DSL explained that pin 40 was also near the end of the socket and susceptible to mishandling or bending during assembly. Subsequent straightening could result in metallurgical fatigue and breakage when under vibration.

The CLU failed in the final phase of lateral vibration tests due to breakage of spot welds securing the CLU mounting tray. There was no apparent failure of any internal components. DSL later testified that the matter of poor spot welds has been rectified in subsequent manufacture of the mounting tray, and therefore the problem has been resolved.

The IDU failed under a longitudinal vibration test at 118 H_Z due to failure of display panel lighting accompanied by internal rattling of one or more components. DSL later testified that the electroluminescent panel power supply module U19 broke loose due to failure of the epoxy glue securement. This was similar to a failure experienced with the RDU of Digitair I equipment. A stainless steel strap is now being provided as positive securement for the U19 component.

During the temperature cycle test following completion of the longitudinal vibration tests, an indecipherable display appeared on the display panel of the SBU. Subsequent inspection by DSL revealed the presence of aluminum shavings in the solenoid valve of the emergency brake feature on the SBU. DSL has developed a prototype air filtering screen to eliminate the fouling of the solenoid valve. However, an explanation was requested with respect to why an indecipherable display would result from fouling of the solenoid valve. DSL testified later that the indecipherable display "R7M" was a corruption of an ROM code indicating that the SBU required servicing. Quality control procedures have been adopted to prevent contamination of the solenoid valve by metal shavings.

Altitude Tests

The Digitair II equipment was subjected to conditions simulating an altitude of 12,000 feet for a 1 hour period followed by an operational check. The altitude was then decreased to 6,000 feet conditions and maintained for 1 hour followed by an operational check. Both operational checks indicated normal operation. The maximum elevation of track above sea level in Canada is 5,339 feet.

Marker Light Luminence Tests

The intent of this test was to compare the effective luminescence or visibility of the ETIS flashing type marker lamp to that of an accepted present day caboose marker lamp.

Prior to testing the luminescence of the 50 watt light bulb installed in the caboose marker lamp it was noted that its filament did not coincide with the centre line or axis of the red lens. This misalignment appreciably reduced the potential luminosity of the red marker light and therefore this built-in deficiency was corrected to obtain a maximum possible luminosity value for each of the test procedures.

The luminescence or brightness of both the caboose marker and the flashing light was first measured at:

(a) the centre line or axis
(b) $+15^{\circ}$ to right and left sides
(c) $\pm 5^{\circ}$ above and below the axis.

It was concluded in the Canadian Transport Commission test report that when looking at both lights along their centre axis there was no perceptible difference in luminosity. The flashing light, however, showed a superior luminosity or brightness viewed from any other angle.

4.0 REGIONAL ANALYSIS

4.1 General

There were seven regional hearings held at various locations across Canada. This was mainly so that those people who were unable to attend the hearing in Hull could voice their concerns. Another purpose of the regional hearings was to determine whether or not there exist any regional variations which could have an effect on the risk of CN or CP operating cabooseless freight trains.

At the hearings, 232 witnesses were heard most of whom appeared at regional hearings. They came from all walks of life, and represented a wide range of interests. The sincerity of these witnesses was reflected in the thoughtfulness of their submissions, many of which undoubtedly involved considerable time and money. Along with public witnesses heard in Hull, the regional witnesses served to assist the Panel greatly in terms of conveying the opinion of the public in respect of the case and to share their own particular experiences and associated concerns.

In general, the public interest submissions aligned to varying degrees with the major arguments made by the railways and the UTU/CRLA in Hull for or against the applications for change to the UCOR. The positions of the respective public interest parties are summarized in the following section; however, in the Panel's view, the evidence given supports the argument that there are no significant regional differences in respect of the proposed operation of cabooseless trains and that the major concern is in respect of the consequences of risks related to the carriage of dangerous goods.

4.2 Those Opposed to the Railways' Applications

Those public interest witnesses that were opposed to the railways' arguments during the regional hearings held the following views, which are not necessarily ordered according to any specific criteria — all of which

were considered by those presenting evidence in opposition to the applications to reduce railway safety:

1. The ETIS and related technological components cannot adequately replace the human senses of sight, smell, and hearing of the crew located at the rear of the train in the caboose.

2. Human judgement based on what is seen, heard and smelled from the rear of a train would be lost.

3. The ability of operating employees to warn the public from impending danger in proximity to trains would be reduced.

4. The quick ability of operating employees to detect the collision of motor vehicles with the side of trains at crossings would be reduced.

5. The quick ability of the operating employees to apply first aid to the injured in case of an accident would be reduced.

6. The quick ability of operating employees to rescue and warn of impending danger in the event of accident near the rear of the train would be reduced, and there would be an added risk if all the front crew were incapacitated or killed.

7. The ability of operating employees to check wayside detector performance would be reduced.

8. The ability to detect defects in track and equipment from the rear would be eliminated.

9. The ability to detect dangerous commodity leaks would be reduced.

10. The ability to detect shifted loads to the rear of long trains would be eliminated.

11. The ability to detect bearing failures, sticking brakes, and fires from the rear of long trains would be eliminated.

12. The quality of visual inspections of passing trains would be reduced.

13. Without the caboose as added shelter, the safety of operating employees in remote areas in winter would be reduced.

14. The chance of trains blocking crossings for a prolonged period would be increased, with attendant dangers of delaying fire trucks and ambulances in emergencies.

15. The quality of pull-by inspections would decrease as they would be performed by disembarking crews who would not have the same vested interest as the embarking crew.

16. The chance of losing the train documentation in a head-on collision, with all crew in the locomotive cab, would be increased.

17. There would be insufficient space in the locomotive cab for all crew.

18. The ability of the locomotive engineer to see at night would be reduced as the conductor needs light to do his paperwork.

19. Not all functions performed by rear crew in a caboose could be performed by the same crew in the locomotive cab.

20. The reliability of the ETIS is not proven and therefore more tests are required.

21. The distance measuring device is not sufficiently accurate.

22. Reliance on the DMD when in possession of an inaccurate consist length may place the engineer in a dangerous position.

23. Reflectorized markers on cabooseless trains would not be safe.

24. The ETIS should not be the responsibility of the locomotive engineer.

25. The spacing of hot box and dragging equipment detectors is too far apart and they are too unreliable for cabooseless train operations.

26. Most small communities lack the knowledge or resources to adequately protect the public from the impact of a dangerous goods derailment with a leak, and cabooseless operations would reduce the chance of quick assistance from the train crew, particularly to the rear of the train.

27. Most urban areas have services that are knowledgeable and properly resourced to deal with a dangerous goods derailment with a leak; however, the population density is such that evacuation is very difficult thereby requiring the most timely and accurate information in the event of such a derailment. Cabooseless operations would reduce the accuracy and speed with which necessary information is available, particularly if the leak is to the rear of the train.

28. Locomotive cabs are currently dirty and without adequate toilet facilities — a problem that would be increased with the rear crew located in the locomotive cab, particularly if there are more than three employees in the cab such as when the rear crew would normally comprise two employees and/or when a road foreman or a regulatory officer is required to ride on the train.

29. The RTC should focus on public perception when approaching questions of safety. There was no evidence that cabooseless operations are perceived by the public to be an acceptable overall risk.

30. The incidents from the general train survey where the rear crew detected problems translate to the potential occurrence of as many accidents.

31. The dragging equipment detectors do not detect anything on the sides of the train nor above the wheels.

32. There would be an increased possibility of delay in situations where defects occur in the rear portion of the train and the crew must conduct repairs.

33. The gradual reduction in equipment, maintenance and inspection on the railways means that the rear crew functions are even more critical for safety.

Other comments by those opposed to the railways' applications included the following:

1. The ETIS should be used in conjunction with the caboose and the rear crew in the caboose.

2. Engine cab noise should be reduced.

3. Radio equipment reliability should be improved.

4. The test and survey methodology are not representative.

5. The railways' economic analyses overestimate the real savings with a cabooseless operation.

6. Comparisons with the U.S. experience are invalid.

7. There should be a second caboose in the centre of long trains.

8. Trains with dangerous goods should have cabooses.

All of the above points will be dealt with in the following chapter on findings and conclusions.

4.3 Those in Favour of the Railways' Applications

VIA Rail Canada, while expressing support for the applications, said their foremost concern was the safety of passengers and the crew who serve them, and suggested that the Committee accord safe railway operations the highest priority in this decision. VIA's other concern was the train delays that may be occasioned by the operation of cabooseless trains, and they submitted that any changes made to the UCOR be made in such a manner that no delays be caused to the operation of passenger trains.[1]

Those who were in favour of the railways' applications mainly cited the potential for reduced rates and improved trade if the cost savings associated with cabooseless operations were passed on to shippers. There was, however, no evidence to substantiate that past cost reductions necessarily resulted in reduced rates except for statutory cost-related rates. Neither was there evidence that would result in a guarantee that any cost reductions arising from cabooseless operations would be passed on to the shippers, in whole or in part, except for the movements under the provisions of the Western Grain Transportation Act.

5.0 FINDINGS AND CONCLUSIONS

5.1 General

The applications before us are for certain amendments and changes to the Uniform Code of Operating Rules (UCOR) which will, if granted, permit CN and CP to operate any freight train without a caboose. The railways intend to install an electro-mechanical device, referred to as an End-of-Train Information System (ETIS) and specifically a model called Digitair II, on the rear car of cabooseless trains, relocate the rear crew in the locomotive cab and otherwise make certain changes to operating procedures and provide additional equipment not now in place. The railways argue that the ETIS is accurate and reliable and that the proposed cabooseless train operations will not reduce the current level of railway safety afforded to the public and railway employees.[1] It is further argued that employee safety would improve with cabooseless operations.[2] The reason why the railways wish to operate cabooseless is, however, to reduce railway expense — a maximum saving before tax which we estimate to be in the order of $57.6 to $77.2 million per year, as detailed in Chapter 2 hereof. The saving does not accrue as a result of laying off rear train crews. The railways have testified that no rear crew will be let go as a direct result of the proposed change to cabooseless operations.[3] According to the railways, the principal reason for reducing expenses is to maintain their competitive position in the North American freight market.[4]

The opposition to the application is centred mainly on claims that the ETIS technology does not completely replace all of the functions that can be performed by the rear end crew in the caboose; therefore a granting of the applications would reduce the current level of railway safety now afforded the employees and the public. Most who opposed the applications considered the possible reduction in safety totally unacceptable, and that the resultant savings to the railways and the experience with cabooseless trains elsewhere are not relevant to the CN and CP case. The possibility of the removing of the caboose being the first step in the laying-off of the rear crew personnel was mentioned as well. Furthermore, some of the opposition to the

applications strongly argued that the onus was on the railways to prove that cabooseless train operation will be risk-free and that the railways have not done this.

As is the norm in any endeavour involving significant change, the change is tested in as close to real conditions as possible. This is to minimize the technological or financial risks of making the decision in favour. Although such testing is always seen by some to be a waste of time and money, it is almost always the prudent thing to do — particularly when safety is a factor. In consideration of its responsibility to protect the public interest, the Railway Transport Committee required extensive testing of both the technological integrity of the ETIS and its performance in the field. The test results are a dominant factor in our deliberations.

It is very easy, in such matters, to argue that the evidence should be of such scope and detail that we can decide "*...without any doubt...*" that safety will not suffer in the slightest as a result of the proposed changes. Common sense, however, dictates that, when a decision pertains to matters that only might be in the future, there cannot be such certainty. In any event, the evidence shows that the perception of what "safety" really means is not a universal understanding. Put another way, when deciding on matters that involve the assessment of risk and consequence, one must accept that the criteria used to make a decision can never be perfect and hence the decision can never be risk free. This brings us to Mr. Romanow's argument that the criminal standard of proof should be applied in the present proceedings in developing the "safety test". Such contention in our view must again be rejected. There is nothing in the present proceeding which calls for a change to the Committee's ruling on the standard of proof to be applicable in similar proceedings before the Canadian Transport Commission as found on page 35 of the September 1985 decision. In that decision, the Committee states:

> *"We agree that when a party makes application to the RTC for amendment to the Commission Regulations, the onus should be on that party to show that the amendment should be made, and if the amendments sought have safety implications, as in this case, then the standard of proof expected may be a high one, but we cannot agree that the criminal standard of proof is applicable to the proceedings on an administrative tribunal such as the Commission".*[5] (Emphasis added)

Our decision is based on what we consider to be the best possible evidence that could be obtained. Moreover, we find that the test data, in combination with other evidence is, in scope and detail, more than adequate to make a decision in respect of the applications before us.

Considering the evidence as a whole, we find that the main questions we must answer in making a decision with respect to the applications are:

1. To what degree, if at all, should the economics of the change to cabooseless train operation be considered?

2. To what degree, if at all, should the experience with cabooseless operations in the United States and elsewhere be taken into account?

3. What really constitutes the public, corporate and employee interests in this case?

4. How accurate and reliable is the End-of-Train Information equipment (in this case the Digitair II model) that is planned to be used by CN and CP and what are the consequences, if any, of electronic or mechanical failure?

5. What are the consequences, if any, of removing the caboose and relocating the rear crew to the locomotive cab?

6. What is the net change in safety, if any, to the employees and the public arising from the transition to cabooseless operations taking into account the operational changes proposed by the railways?

7. Does the net change in safety, if any, vary under different conditions or locations?

8. For situations or conditions where the net change in safety is an increase in hazard to the employees and/or the public, are there reasonable means to counter those hazards?

5.2 The Economics of the Change

As pointed out by many intervenors, the applicant railways have significantly emphasized the importance of the savings to be made by them if they are permitted to operate freight trains without cabooses and the importance of those savings to the continued viability and competitive position of railways. Before considering the economic evidence further, we must decide to what degree we should take such information into account in weighing the pros and cons of granting or denying the applications.

In a number of previous safety-related proceedings before the RTC, the economics of change were considered but in a different context than this case presents. In the past, formal safety-related decisions normally involved the RTC imposing a duty on the railways to take certain actions that the RTC felt would improve an unsafe situation. The imposition of such duties required consideration of the economic burden associated with the implementation of those duties. A prime example of this is the "Show Cause Hearing Decision on Railway Safety" of September 30, 1981, that followed the

Report of the Honourable Mr. Justice Samuel G.M. Grange on the Mississauga Accident. That Show Cause proceeding was very much concerned with the practical and economic ability of the railways to implement the recommendations made by Mr. Justice Grange. For example, in that report the RTC panel hearing the case stated:

> *"The Panel also concludes that it is in the public interest to look beyond the Grange recommendations for other options that may yield the results intended but at a lower cost."* (Page 13)

The situation in this case is different. The initiator of this proceeding is not the RTC seeking to remedy a possible or known safety deficiency. The initiators are the railways who wish to reduce costs by operational changes which may also alter the level of safety. This is an important distinction to keep in mind when considering the significance of economic evidence.

If the applications were proven to be free of additional risk, if granted without condition, then it would seem totally unnecessary to consider the size or impact of the savings that would accrue to the railways. The decision would likely be to permit cabooseless train operations without condition, as the railways have asked, as there would be no additional risks. The Panel would not therefore impose any duties or expenses on the railways that they would not otherwise incur, and the economic evidence would be of use only as general information and to explain the main reason for the applications.

If the applications were proven to present substantial additional risks that could not be overcome by the imposition of conditions, the economic evidence would still be of questionable relevance. In this situation the decision would likely be to deny the applications in their entirety, as the UTU and other opposing interests would have. The railways would thereby be no better or worse off financially than they otherwise would be. The economic evidence would therefore be of use only as general information and to explain the main reason for the applications.

If, however, the applications were proven to present small net additional risks or substantial risks that could be overcome by the RTC imposing conditions that the railways would not otherwise implement, then and only then would we conclude that the economic evidence may be relevant. This is because, in that situation, the railways would be required to incur expenses associated with the conditions that they otherwise would not. We would view the placing of conditions on the decision as the imposition of obligations that might not otherwise be and therefore the size of the savings are relevant for it would be those forecasted savings that would be reduced by the cost of the conditions. In any event, it is our opinion in this case that no decision should be made that would foreseeably result in an overall additional risk to the public and/or employees.

In other words we conclude that an application for an operational change, that might involve the increase in net risk to the public and/or employees, should be judged exclusively on the determination of the level of that risk and whether or not conditions should be placed on the railway to alleviate those net additional risks, if there are any such risks. We further conclude that the relevance of economic information, in such applications, should be centred on the determination of the ability of the applicant to afford the actions necessary to implement the conditions, if there are such conditions. Otherwise, the economic evidence associated with such applications serves little more than for general information.

This is a conclusion that should not be confused with the treatment of economic evidence tendered by railways in respect of potential obligations to remedy safety deficiencies or in respect of show cause proceedings such as the often quoted "Show Cause Hearing-Decision on Railway Safety" that followed the Grange Inquiry into the Mississauga Accident.

In this particular case, we have reviewed in detail the economic evidence and, irrespective of the weight that we may place on that evidence in the context of the above, we conclude the following:

1. It is clear that the maximum savings that would accrue to CN and CP, if they were permitted to operate all freight trains without cabooses, would be in the order of $57.6 to $77.2 million per year before tax.

2. If some but not all freight trains were operated without cabooses, the associated savings would be in the order of magnitude as noted below:

% of Cabooseless Trains	Savings to CN and CP ($ million before Tax)
10%	5.8 - 7.7
20%	11.5 - 15.4
30%	17.3 - 23.2
50%	28.8 - 38.6
75%	43.2 - 57.9

3. Any savings that accrue to the railways in the order of magnitude mentioned above could have a measurable effect on their competitive position relative to other railways or other modes of freight transportation.

4. Any savings that accrue to the railways in the order of magnitude mentioned above could result in lower freight rates for certain commodities or routes and would result in a lowering of the rates applicable to grain under the Western Grain Transportation Act.

5. Any savings that accrue to the railways in the order of magnitude mentioned above could be used by the railways on goods and services that could improve

safety or could offset the costs associated with any conditions that may be required for the applications to be approved, if conditional approval is the decision.

6. There is no economic evidence presented on savings made by other railways operating cabooseless trains that substantiates the degree of savings forecast by CN and CP.

7. In addition, the savings estimated by the railways will be less than anticipated, if there are delays created by the operation of cabooseless trains, as has been claimed by opponents to the applications.

5.3 Experience Elsewhere

The applicants made much of the fact that freight trains are operated without cabooses in other countries. Particular emphasis was given to the cabooseless experience in the United States. The main reason for this was apparently to point out the acceptability of cabooseless train operations elsewhere and to present the associated safety record as an example of what would or would not occur if cabooseless train operation is permitted in Canada. Before considering the significance of the experience with cabooseless train operation elsewhere, we must decide to what degree we should take such information into account.

Those opposed to the applications argued against the relevance of this type of evidence and concentrated on the fact that the situations being described are not directly associated with the Canadian milieu.

No one seriously argued against the fact that there are numerous countries where cabooseless trains operate. The Panel finds that the experience in the United States is associated with a physical situation and circumstance that is not exactly the same as here in Canada; however, we also

find that circumstances within which cabooseless trains now operate in the U.S. are similar to those found in Canada.

In the railway industry, there have been many historical similarities between the United States and Canada. In particular, many of the rules and standards of the Association of American Railroads (AAR) have been adopted in Canada in order to facilitate trade. Nevertheless, the applicability of AAR standards to Canada is always considered in light of their adequacy in the Canadian environment and circumstances. The RTC does not automatically accept what occurs in the United States for application here in Canada. In this case, the Panel does not accept evidence of the U.S. experience as sufficient proof in and of itself to decide on the applications. That is demonstrated, in part, by the RTC's requirement that the Canadian railways should field test the ETIS under the RTC controlled conditions before a decision pertaining to cabooseless operations on Canadian railways could be made.

The evidence on the U.S. experience relied heavily on the national statistics associated with accidents before and after cabooseless trains became significant in the U.S. Testimonials from U.S. railway officials served to reinforce what the nation-wide statistics implied by relating carrier-specific situations and experiences. In brief, this evidence showed that the operation of a significant proportion of cabooseless trains in the United States has not resulted in a perceptible change in a railway's accident frequency or severity. That evidence also indicated that the forecast of major reductions in the level of railway safety, made by opponents to cabooseless operations in the U.S., simply has not come to pass.

Given all of the evidence pertaining to the significance of the global and U.S. experience, we find the following:

1. The decision on the applications cannot be made solely on the performance of cabooseless train operations elsewhere in the world.

2. The RTC field tests of the ETIS, the general train survey and the ETIS laboratory tests have yielded direct evidence on what could be expected on CP and CN under most geographic and environmental Canadian extremes. Therefore, the evidence associated with the RTC tests and survey is considered the evidence that is more directly relevant than the evidence pertaining to cabooseless train safety performance in other environments and situations.

3. Nevertheless, the data base associated with the change in frequency and severity of accident rates as the proportion of cabooseless trains increased in the U.S. is useful as supporting evidence of secondary relevance.

4. Similarly, the site-specific evidence of the U.S. railway officials pertaining to operational changes they made to accommodate cabooseless trains and other related experience forms a backdrop of ideas that may be of use in the Canadian environment.

5.4 The Public, Corporate and Employee Interests

Although it is the railways' responsibility to ensure their operations are safe, the RTC has a primary mandate to protect the safety of the public and of railway employees. At the same time, by virtue of the National Transportation Policy, the RTC must ensure that the main corporate interests of efficiency and profit are not unduly diminished. Furthermore, by that same policy, the RTC is charged with the responsibility to ensure that railway costs are low and the railway system is adequate so as to favour reasonable and competitive freight rates for the shippers and to foster strong domestic and international trade. The RTC is otherwise charged to take into account, through its legislative authorities, the economic well-

being of Canadians. The proper balancing of all of these factors is the stock-in-trade of those of us who have the duty to make regulatory decisions.

In this particular case, there is no question that the prime directive is to ensure that the net risks that the public and the employees must face as a result of the presence of railways does not increase as a result of operational changes. The forecasted savings, improved competitive position, and improved profits are secondary. Similarly, the matter of job security of the rear crew is a secondary consideration. Indeed, both railways have stated that they place safety first. For example, CP stated in their application *"CP Rail seeks to operate freight trains without cabooses wherever such an operation will not reduce safety for employees or for the public"*.[6]

It is our view that the general public are entitled to a level of safety that is commensurate with the risks they voluntarily take or accept as normal in everyday life. For example, the public accepts the risks of operating a private automobile, crossing a busy intersection, driving a tractor, working on a construction site, swimming at the beach, walking in a thunder storm, smoking, and so on. We do not believe that it is reasonable to demand that all risks associated with railway operations be removed. We acknowledge and accept that there will always be risks associated with railway operations. We therefore view all evidence given by the public interest witnesses within this context.

The public interest in the risk of operating railways is often intangible. It is not as easy to measure as with the balance sheet of a railway company, statistical trends, or test results. Much of the evidence tendered as public interest evidence tends to be emotional, without technical or scientific support. We do not, however, take such evidence lightly. At the same time, we cannot make our decision on the basis of the numbers of witnesses alone.

The employee interests in this case are strongly associated with safety to the public and themselves, as well as for job security of rear

train crew. However, it is our opinion that the implication of caboose less operations to future job security is not an issue since the railways have testified under oath that no one in the running trades will be laid off as a direct result of caboose less train operations.

The evidence in support of the employee interests, as expressed by local "Save the Caboose Committees" and individuals, was heavily weighted by what has been referred to by the railways as "anecdotal evidence". The railways characterized this as less than relevant since the incidents referred to did not occur on the prescribed test days. To us, the fact that much of the evidence of employees related to isolated instances, usually where the rear crew performed a safety-related duty, in no way renders that evidence of little or no relevance. Employee witnesses were tested through cross examination and their evidence was duly noted and considered. It is true that anecdotal evidence of this type cannot be compared in a statistical fashion, as with the controlled test and survey results. It was not always possible for the Panel or the applicants to verify independently if there were any extenuating circumstances pertaining to these occurrences, as with the general train survey. These instances nevertheless pointed to some types of situations that may not have occurred in the general train survey and to possibilities of what might be lost if there were a transition to caboose less operations.

As noted before, it is the RTC's responsibility, and within its jurisdiction, to ensure the safety of the public. This is done by requiring the railways to accept certain obligations. These obligations may in turn be required of the employees by the railway management. It is these obligations that were the subject of much discussion relative to the safety of the public and the need to retain the crew at the rear of the train in a caboose. To be fair, we believe that it is necessary to make a distinction between that which prevents or reduces hazards to the public solely caused by the presence of the railway operation and that which prevents harm to the public as a result of the public taking undue risks in the proximity of trains. The distinction is subtle but it is extremely important to the deliberation of the merits of this case.

In this latter respect, we conclude that there are two different types of hazards that face the public. One hazard is where the public is placed at risk through no fault of their own. An example of this would be the derailment of tank cars containing dangerous gases that leak and drift to private property. Another example would be the failure of automatic crossing protection at a crossing. Yet another example would be a fire, started by a passing train, spreading to a farm property with dwellings. In these instances, a failure or a danger associated with the operation of a railway either resulted in an intrusion of a hazard into space where that hazard would not be expected, or in a situation where a member of the public was inadvertently placed in danger in a location or situation where that person should rightfully expect to be protected. It is the obligation of the railway to avoid this type of risk and the obligation of the RTC to ensure that this type of risk is minimized.

The second type of hazard results from an incident where the public place themselves at risk by taking chances that they know they should not take. An example of this would be an individual crossing a railway right-of-way between stationary railway cars which can, without warning, start moving and trap the trespasser. Another would be a motorist attempting to beat an oncoming train at a crossing and losing the race. Yet another would be a parent directly or indirectly allowing a child to play in proximity to railway tracks without supervision. A further example would be the existence of a fire on the right-of-way started by persons other than railway employees. These types of risks are beyond the direct control of the railways and the regulatory body. There is a limit to how far people can be protected against themselves and a limit to the regulatory steps that can be taken in this respect.

There is evidence that the rear crew of freight trains have played a role in reducing the consequences of the hazards created by the public taking risks in proximity to railways. Indeed, the evidence before us has shown that they saved lives and reduced property damage as a result of their vigilance from the caboose. This has been a valuable public service on the part of the rear train crews and is a service that any good citizen should

perform, on or off the job, if the situation presents itself. Although this type of protection may have become accepted as a public service, it is in fact a coincidental function of the conductor and not one which bears directly on the safe operation of a train.

We therefore find that the extent to which the consequences of the public taking risks in proximity to railways may increase if cabooses are removed from freight trains, and to which the consequences of incidents beyond the control of the railway may also increase, are not issues for which we can fairly require the railways to compensate.

In summary, on the general issue of public, corporate, and employee interests and related evidence, our main conclusions are:

1. The public interest in this case is mainly the concern that the risk of freight train operation may increase if the caboose is removed and the rear crew are placed in the locomotive cab; and, that the hazards faced by citizens in proximity to a railway right-of-way may increase.

2. The employee interest in this case is mainly the concern for reduced employee safety and job security.

3. The corporate interest in this case is mainly cost reduction and improved competitive position through the use of modern technology and operational changes.

4. It is the obligation of the railway and of the RTC to ensure that there are no net additional risks to the public and to the employees that are within the control of the railways to rectify, if the applications are approved.

5.5 How Accurate and Reliable is the ETIS and What Are the Consequences of Electronic or Mechanical Failure

The End-of-Train Information System (ETIS), and more specifically the Digitair II model, is proposed to replace the caboose and some of the functions that the rear crew can perform only when located in the caboose. In detail, the Digitair II model of the ETIS is capable of performing the following functions, among others:

1. Measures the brake pipe pressure at the last car thereby verifying continuity of the air brake system and ensuring the train is intact, and transmits same by radio to the locomotive cab.

2. Permits the application of the emergency brake from the rear car by radio control from the locomotive cab when actuated by the locomotive engineer.

3. Detects the motion and direction of the last car and displays same before the locomotive engineer.

4. Measures the distance moved by the locomotive from a particular point.

The field and laboratory tests carried out on the Digitair II system and its components, with a few exceptions, proved to function as designed. The railways employed a "reliability factor" determined essentially on the basis of the number of times the particular function worked when there was an opportunity for it to work. The reliability so determined indicated that the functions worked as designed with a reliability factor of over 90%.

The reliability of a device is measured in terms of the number of times that it functions relative to the number of opportunities that it has to function. The significance of the resultant percentage, however, varies according to the purpose for which the device is put. Clearly, the

reliability of an interior light in a private automobile need not be as high as the brake light on the same car. If the interior light worked 98% of the times it was activated, that would not give rise to great concern, and yet, if the brake lights failed twice in every 100 applications, one would be concerned. The question we must therefore answer is whether or not the "reliability factors" for the Digitair II are appropriate, given the functions to be performed and the consequences of failure.

The ETIS is designed to "fail safe" with the exception of the end-of-train emergency feature. In other words, if there is a failure of any kind, an erroneous display that could be acted upon by the locomotive engineer is not possible. If, however, there is a battery failure or an ETIS radio failure, the rear emergency brake feature cannot be actuated. It can only be deployed if the battery is properly charged and the ETIS radio functions. However, failure of either of these features is displayed in the locomotive cab, which permits advance warning that the emergency brake feature is not available.

We have reviewed the test results in detail — both those involving field tests and those involving the environmental laboratory tests. In brief, and in consideration of the consequences of failure of the ETIS or any component thereof, we find that:

1. All measurement, radio transmission and display functions associated with all components of the Digitair II model of ETIS perform in an adequately accurate and reliable fashion.

2. There are no serious consequences as a sole result of failure of any measurement, radio transmission or display function of the Digitair II model that cannot be accommodated by revised operating instructions.

3. The consequences of continued operation of the train for short distances with a malfunctioning distance

measuring device or direction motion detection device, are not considered to be serious.

4. When the batteries are charged, the rear emergency brake feature of the Digitair II model ETIS performs in an accurate and reliable fashion.

5. The consequences of continued operation of a train, with all of the ETIS batteries having failed, are potentially serious, as the rear end emergency feature could not be actuated.

5.6 Effect of Relocating the Rear Crew in Locomotive Cab

General

The effect of relocating the rear crew in the locomotive cab deserves serious consideration. All other issues such as the reliability and accuracy of the ETIS, the economics of cabooseless train operations and so on were disputed amongst the principal parties, but it is with this issue that the main contentions have been found.

Indeed, the measurement of these consequences is difficult for we are delving into the area of what might occur in the future if the caboose were removed and the rear crew relocated. In order to quantify that measurement, the RTC required a general train survey to measure the frequency of occurrence of "safety-related" incidents first observed by the rear crew. In addition, and as noted earlier, a number of interested parties brought forth anecdotal evidence which we consider to be supplemental to the controlled survey information. We classify this latter type of information as supplemental because, unlike the general survey data, it constitutes a number of isolated instances without a complete picture of the system-wide circumstances within which those instances occurred. The anecdotal evidence did, however, expand our understanding of the nature of things that the rear crew may not be able to do if they were relocated to the locomotive cab.

It is obvious that, if all things remain the same, the "current level of railway safety" would also remain the same. The current level of safety is best and most simply defined by the current frequency of accidents which, relative to the traffic levels, has been decreasing for some time. As accidents do occur, and considering their causes, one must observe that employees, like machines, are not 100% perfect 100% of the time — including the rear crew of a train. That is not a criticism; rather, it is a simple statement of fact that will remain with us and should be accepted by all parties.

It is equally evident that all things have not and will not stay the same. The level of railway safety has changed over the years. To the extent that the accident reporting systems reflect reality equally well over time, and to the extent that accident frequency normalized by train mile output reflects the level of safety, the past upward trend in railway safety in Canada has been commendable. This trend has continued since the peak risks of 1974.

CN and CP have expressed pride in this downward trend in accident rates since 1974 and also in the low level of accident frequency relative to other North American Class I railways. The Railway Transport Committee of the Canadian Transport Commission, over the years, has also brought about a number of safety initiatives which were applied by the railways as a result of Orders of the RTC that might otherwise not have taken place. Furthermore, it is the railway employees who are on the front line, and their contribution to the safety record should not be forgotten; therefore railway management must also credit their employees — including the rear crew.

There is really no better way to define the current level of safety than through current accident frequency data. It is everyone's goal to ensure that the accident rate trend will continue to decline. For purposes herein, it is the problem of determining the change, if any, in the current accident rate if the applications are granted.

In this context, what we are really concerned with is whether or not the chance of any of the aforementioned types of accidents occurring would increase if cabooseless train operations are permitted, and whether or not the severity of any accident that now occurs or that may occur as a result of the transition to cabooseless trains would increase. We find that either an increase in accident frequency or an increase in the consequences of the same rate of accident occurrence amounts to a decrease in the level of safety. We also find, however, that it is the net aggregate change in the level of safety that is really of concern — not whether or not the frequency of a particular type of accident may change.

In theory, the measurement of the consequences of change requires the identification of two components of risk. One component is the forecast of the change in the frequency of occurrence of an event (increase or decrease), including the elimination of an existing type of occurrence and the creation of a new type of occurrence that otherwise would not occur but for the change. The other component is the estimate of the severity of an occurrence and the alteration (increase or decrease) of that severity as a result of the change.

We have identified the major types of accidents, the major types of associated causes and the current frequency of occurrence. We have also summarized the test evidence pertaining to the survey of incidents first identified by the rear crew. From these two pieces of information we feel that it is reasonable to make conclusions with respect to the alteration of the current frequency of certain accident types as a result of the rear crew being relocated to the locomotive cab. Once having identified those accident types that might increase in frequency relative to those that might decrease as compared to those that might not change at all, we believe that an assessment of the potential change in severity of the classified accidents by cause can be made. Finally an examination of the consequences of the proposed change of location of the rear crew can be made from which the core of our decision will evolve.

Derailments

A. Track-Related Derailments

Track-related defects can be detected by the rear crew under certain conditions, namely: a) if the rear crew is observing the track from the rear; b) if the passage of the train over the defective track does not derail the train; c) if the passage of the train results in the making of a pre-existing track defect more visible; and d) if the track defect is in fact visible. A derailment due to a track defect that is not observed occurs: a) if the defect is sufficient to derail the next train passing that point; b) if track inspection forces did not pass that defect or did not detect the defect before the next train; and c) if the front end crew on the next train did not see the defect with enough time to stop or otherwise prevent a derailment. The presence of the rear crew in a caboose on the rear of a train could prevent a track-related derailment if these circumstances exist. There are approximately 100 derailments per year due to track-related matters, on CN and CP, that occur with the rear crew in a position to detect track defects.

During the 19 day general train survey a range of 25 to 34 instances were recorded involving the first detection by rear crews of track defects (survey category 7), and 48 to 56 instances involving spring switch faults (survey category 9). Where track defects were detected, however, all trains passed over the faults without a derailment. During the train survey test days there were no main track derailments due to track defects. In the case of the spring switch faults, the danger only exists for trains operating in the facing point direction in non-signal territory. We are not aware of any derailments due to spring switch faults.

Considering all of the evidence pertaining to this issue, we conclude the following:

1. It is possible that a track defect related derailment might be prevented by the rear crew observing the defect. However, that possibility depends on many circumstances and, therefore, the probability of the prevention of a track defect related derailment by the rear crew in a caboose is negligible.

2. The probability noted in 1. is greater on non-signalled track and greater still on track that is not maintained at a high level or inspected frequently.

3. The probabilities noted in 1. and 2. may result in a very insignificant increase in the risk of derailment of a train passing over the track that has last been crossed by a cabooseless train.

4. A derailment should not occur as a result of a misaligned spring switch in signalled territory and, therefore, if all spring switches are in signalized territory, there would not be an increase in the risk of a derailment due to a misaligned spring switch if the rear crew were relocated to the locomotive cab.

5. Therefore the relocation of the rear train crew to the locomotive cab would not significantly change the risk of derailment due to track defects that can be seen.

B. Equipment-Related Derailments

With respect to derailments caused by equipment defects, it is clear that those equipment defects that could cause a derailment and be seen by the rear crew in the caboose, could not possibly be seen if the rear crew were relocated to the locomotive cab. To that extent, the relocation of the

rear crew to the locomotive cab would increase the risk of derailment of cars within sight of the last car of the train.

There are approximately 67 equipment related derailments per year. Obviously, the equipment defects giving rise to these derailments did not all occur within sight of the caboose for they should have been detected if they could have been seen. Some of the defects could not be seen. Probably a few of these defects would have been seen but, for one reason or another, were not seen by the rear crew. What is important is that the current level of safety involves about 67 equipment-related derailments per year that are not preventable by the rear crew in the caboose.

During the 19 days of the general train survey, the following frequencies of equipment defects, which were discussed in detail in Chapter 3 hereof, were noted:

1.	Sticking Brakes	173 to 184
2.	Brake Pipe Continuity Problems	54 to 82
3.	Mechanical Defects	9 to 13
4.	Hot Box/Dragging Equipment Detected	6 to 9

In the case of the sticking brakes, a large proportion of those incidents identified proved to result from things other than defective equipment. Nevertheless, sticking brakes did occur and were detected first by the rear crew but, it is our opinion that sticking brakes per se are not an indication of impending derailment. Sticking brakes do, however, contribute to metallurgical damage to wheels which can lead to thermal cracking of the wheel and eventually, in rare cases, to derailment. The evidence is that sticking brakes can be detected by "hot wheel detectors". The Panel is also aware that it is more probable that sticking brake problems exist on trains just after leaving a yard. Sticking brakes on cars that can be seen from the caboose can also be detected during pull-by inspections, by wayside forces and at times by personnel other than the rear crew in the caboose. Moreover, we are aware that sticking brakes can be a result of improper air brake handling and can be rectified by proper usage of the air brake system. In summation, it is our opinion that:

1. The relocation of the rear crew to the locomotive cab will result in certain incidents of sticking brakes on cars that could be seen by the rear crew in the caboose not being observed by the rear crew and not being detected as quickly as is now the case.

2. Of those incidents of sticking brakes that will no longer be detected from the caboose, most would not cause a derailment.

3. Of those incidents of sticking brakes that might cause a derailment, and that would no longer be detected by the rear crew from the caboose, most would probably be detected prior to derailment by those other than the rear crew in the caboose or by mechanical means such as HBDE/hot wheel detectors.

4. Of those incidents of sticking brakes that would cause a derailment prior to being detected by any other means, and that would no longer be detected by the rear crew from the caboose, such derailment would be restricted to the rear part of the train (that which could otherwise be seen from the caboose).

5. The consequence of such an improbable derailment would only result in property damage unless dangerous commodity cars are involved with a leak and that leak posed hazards to the public. If, however, no dangerous commodity cars were marshalled within sight of the rear of the train that very small additional risk due to relocation of the rear crew to the locomotive cab would also be eliminated.

6. The additional risk of such property damage would be mostly eliminated with the placing of hot wheel detectors a suitable distance from each railway yard.

With respect to brake pipe continuity problems encountered during the general train survey, most instances involved normal operating procedures. In a cabooseless train situation, the ETIS would immediately inform the locomotive engineer of the situation, as it would with any other brake pipe continuity problem. In this respect we find that, whereas air brake pipe continuity problems can be very serious if undetected, the relocation of the rear train crew to the locomotive cab will not increase the risk of derailment due to air brake pipe continuity problems, if the ETIS is properly functioning and the locomotive cab displays are properly observed.

With respect to the observation of mechanical defects by the rear crew in the caboose that should have been detected during terminal standing or pull-by inspections, this relatively infrequent event involved such things as a leaking hose bag, missing brake shoes, loose ladders and other such conditions which, although not proper, would not result in imminent derailment or serious danger to anyone. Such conditions should not be let go by terminal car inspectors if they do their job properly and that requires adequate and qualified employees to do the job along with close supervision. If there is indeed a risk here that the relocation of the rear train crew to the locomotive cab would result in such defects, that risk would be associated only with those cars which could be seen from the rear of the train. As well, that risk would be small and would only go undetected until the next pull-by inspection. We do not believe that the consequences of a delay in detection of such a minor risk would pose any additional hazard to the public or any significant hazard to railway employees — particularly if dangerous commodities are not marshalled to the rear of cabooseless trains.

With respect to the detection of hot boxes and dragging equipment by the rear train crew in the caboose and not by wayside hot box and dragging equipment detectors, it is clear that undetected hot boxes or dragging equipment do pose a threat of derailment. It is also evident to us that,

irrespective of the frequency with which the rear crew detects such danger, the one additional situation that could have serious consequences is that involving a dangerous goods leak. Currently, about 10% of all derailments are due to bearing failure and about 3% due to dragging brake gear. If the wayside HBDE are functioning properly, no failing bearing or piece of equipment dragging under the wheels should go undetected. We know that neither machines nor humans are perfectly reliable. We are also aware that overheated roller bearings can fail within the current HBDE spacing without being detected. And, because of this, there are derailments due to bearing failures and dragging equipment. The question is whether or not there will be more derailments due to these defects if the rear train crew were relocated in the locomotive cab. In this respect, we find the following:

1. The relocation of the rear crew to the locomotive cab may result in additional derailments due to bearing failures in the rear part of the train that the rear crew would be able to see if they were located in the caboose and that, for whatever reason, wayside HBDE detectors are unable to detect.

2. The relocation of the rear train crew to the locomotive cab may result in increased frequency of derailments due to dragging equipment for those instances when the rear crew would have been able to see tell-tale marks or hear tell-tale noise to indicate the defect.

3. The consequences of the additional derailments referred to in 1. and 2. would only amount to property damage, posing no additional hazard to the public, if no dangerous goods were involved in the derailments; the consequences to the employees in the locomotive cab would similarly be insignificant except where dangerous goods were involved.

4. It is our opinion that any additional consequences of such bearing failures would result only in property damage as long as dangerous commodities were not marshalled within sight of the rear of the train.

C. Operations-Related Derailments

With respect to derailments due to operational deficiencies, most causes can be traced back to employee error involving UCOR violations, train control or marshalling defects or other employee failures. Operations-related derailments currently account for about 18% of all derailments. Where rear train crews are relocated to the locomotive cabs so that all train employees would be in direct communication with each other, the opportunity to cross check operational actions or inactions increases. Also, the chance of committing rule violations, which presently cause about 11% of all derailments, would be reduced. During the general train survey there were no incidents, which could be classified as an employee failure, that were first noted by the rear train crew that could have caused a derailment.

We therefore find that the relocation of the rear train crew to the locomotive cab will probably decrease the frequency of derailments due to operating employee error. These now account for 18% of all derailments.

D. Miscellaneous Causes of Derailment

With respect to causes of derailments other than those due to track, equipment or operations defects, there are a few causes that could be influenced by the relocation of the rear crew to the locomotive.

The rear crew are capable of detecting improperly loaded cars located within sight of the caboose. Loading defects currently account for 5% to 6% of the total derailments. During the general train survey, rear crew first observed shifted or protruding loads and loose strapping 40 to 44 times over 19 days. However, on analysis, we find that the majority of incidents were not impending causes of derailments. Such items as loose and

dragging strapping, open doors, loose dunnage, tarpaulins and chains are not likely to cause derailments. It is more likely that they may cause injury to persons located close to the passing train. We were not told of any such incident having ever occurred.

We are of the opinion that if cars with loads prone to protruding or shifting, that would be seen by the rear crew, are not marshalled within sight of the rear of the train, no additional risk would result from the relocation of the rear crew to the locomotive cab as a result of improperly loaded cars.

We therefore find that the relocation of the rear train crew to the locomotive cab may increase the risk of personal injury to those in proximity to the train due to delays in detecting loose or shifted loads in the rear portion of the train that would otherwise be seen by the rear train crew in the caboose.

During the general train survey it was noted 35 to 40 times in 19 days that defects were found on passing trains by the rear train crew. These situations were discussed in Chapter 3 hereof. We believe that such defects are quite often the cause of a derailment and are therefore relevant to the immediate discussion. However, we fail to see why such defects could not be seen by the rear train crew once they are located at the front of the train, particularly in situations where one train is static and crew can position themselves on both sides of the track to observe the passing train. We therefore find that the relocation of the rear train crew to the locomotive cab will not decrease the ability to detect dangerous conditions, on passing trains, to the extent that derailments will increase in frequency.

E. Summary of Derailment Causes

In consideration of the above, and in respect of the consequences of relocating the rear crew to the locomotive cab on the frequency and severity of derailments, we conclude the following in summary:

1. The risk of derailment due to track defects would not significantly change.

2. The risk of derailment due to sticking brakes on cars within sight of the rear of the train would not significantly change if hot wheel detectors are located a suitable distance from yards.

3. The risk of derailment due to brake pipe continuity problems may decrease.

4. The risk of derailment due to bearing failure on cars within sight of the rear of the train may marginally increase but the results of such derailments would most probably only be property damage if dangerous commodities were not marshalled within sight of the rear of the train.

5. The risk of derailment due to dragging equipment may marginally increase.

6. The risk of derailment due to rule violations, improper train control, and other employee failures would decrease.

7. The risk of derailment due to improperly loaded cars located within sight of the rear of the train would not increase if car loads prone to shifting or protruding were not marshalled within sight of the rear of the train.

8. The risk of derailment due to other causes is not seen to increase or have any effect on the safety of the public or railway employees.

Train Collisions

Most collisions are caused by employee error. In 1984/85 for example, 93.7% of all collisions were due to employee error.[7] Of these, the principal problems were in the areas of improper braking, excessive speed, improper switching, and crew communication deficiencies. Most of these collisions were minor sideswipes within yard limits and not head-on collisions between trains as some might conclude at first glance.

During the general train survey, there were no instances noted where the rear train crew observed something or took action that prevented a collision. During the 19-day survey period, however, there were two side collisions between railway cars in a yard.

As noted earlier in respect of derailments, it is our opinion that the relocation of the rear train crew to the locomotive cab would reduce the risk of train crew error. Therefore, we believe that the risk of head-on collision due to employee error would be reduced with the rear crew in the locomotive cab.

With respect to collisions due to equipment failure, vandalism or other causes, we do not see how the relocation of the rear train crew to the locomotive cab would in any way increase that risk.

With respect to the potential change in risk of a collision due to the rear protection of trains by flagging and due to the fouling of double track — all pertaining directly to the proposed UCOR modifications — these matters will be dealt with later.

In consideration of the above, and in respect of the consequences of relocating the rear train crew on the frequency and severity of collisions, we conclude the following in summary:

1. The risk of collision due to employee error would decrease.

2. The risk of collision due to equipment failure would not change.

Crossing Accidents

According to RTC records, in 1985 there were roughly 600 crossing accidents;[8] the frequency of the train striking a vehicle compared to that of a vehicle striking a train is about 3 to 2. As to cause, we are not aware of any crossing accident which could be attributed directly to any action or inaction of the operating crew of a train. Inevitably, the cause rests either with a mechanical malfunction of a road vehicle, vehicle driver error, or intentional and suicidal actions of the vehicle driver. To this extent, and barring any evidence to the contrary, we find that the relocation of the rear crew to the locomotive cab would in no way increase the frequency of crossing accidents.

Previously, we found that it was not reasonable for the RTC to oblige railways to ensure that post-accident consequences are minimized for accidents over which they have no control. In the case of crossing accidents, it is understood that the rear crew may detect a collision involving a road vehicle on the side of a train, which may not otherwise be detected as quickly. It is also understood that, if the rear train crew were relocated to the locomotive cab, the risk of failure to immediately detect a side train collision at a crossing may increase. However, we do not see this as a matter for which the railways should be held responsible. We therefore find that the relocation of the rear train crew to the locomotive cab would not increase the consequences of crossing accidents over which the railways have control or for which the railways should be held responsible.

Indeed, it is very possible that the consequences of the more frequent and more severe crossing accidents, where the train hits a vehicle, could be made less severe if the rear train crew is located at the front of the train along with the first aid equipment such as stretchers, etc., which are now housed in the caboose.

In consideration of the above, and in respect of the consequences of relocating the rear train crew on the frequency and severity of crossing accidents, we conclude the following in summary:

1. The risk of crossing accidents occurring would not increase.

2. The consequences for the general public of vehicle-to-train collisions may become more serious but that is not a matter that is solely the responsibility of the railways or that the railways could directly prevent.

3. The consequences of train-to-vehicle collisions may become less serious and would likely offset any additional consequences noted in 2. above.

Other Consequences

In the foregoing, the consequences of relocating the rear train crew in the locomotive cab on the frequency of certain types of railway accidents have been explored. In some cases the consequences on the severity of those types of accidents were also discussed. There would, however, be other consequences associated with the proposed relocation of certain crew. For instance, there were a number of so-called safety-related incidents identified in the general train survey that would not, in and of themselves, increase the frequency of derailments, collisions, or crossing accidents. Nor would they make the consequences of those events more severe. Nevertheless, those incidents were also felt by some to pose additional hazards to the public and/or the railway employees if the rear train crew were relocated to the locomotive cab and the ETIS replaced the caboose. Furthermore, there were a number of concerns raised by public interest witnesses which were not contemplated in our tests. These "other consequences" will be dealt with here.

A. Detection of Leaking Cars of Dangerous Commodities

Although there were no incidents of rear crew detecting leaking cars of dangerous commodities en route during the general train survey, and although leaks in dangerous commodity cars are normally detected during standing inspections in yards, this is a service that the rear crew could perform at the rear of the train. However, it would be mainly through the sighting of a liquid or gas escaping and thereby would be mainly restricted to cars located within sight of the caboose. It is also possible but unlikely that a leak of a dangerous commodity from a car that is out of sight of the caboose would be smelled by the rear train crew in the caboose.

We therefore find that the relocation of the rear train crew to the locomotive cab would decrease the chance of detecting a dangerous commodity leak in those cars that are within sight of the last car in the train. If no dangerous commodity loads were marshalled within sight of the rear of a cabooseless train there would be no additional risk.

B. Train Striking Vehicle at Road Crossing at Grade

Clearly, the crew in the caboose would not be in a position to first detect or prevent the train from colliding with a vehicle fouling the track at a crossing if the train were in a forward motion.

Reverse movements without an employee at the rear of the train are not now permitted under UCOR Rule 103. In situations where a cabooseless train is moving in reverse towards a crossing, the provisions of this Rule would apply, thereby eliminating the risk of a collision with a vehicle fouling the track at a crossing.

C. Fires On or Adjacent to Tracks

It is possible for passing trains to cause fires. During the general train survey a maximum of 4 fires were detected first by the rear train crew over 19 days, although it was unclear whether or not those fires

were out of control or were caused by the passing train. For reasons stated earlier, we do not believe that we should oblige the railways to ensure that all fires on their property should be immediately detected, irrespective of the source of that fire. We do believe, however, that the railways should ensure that the chance of fires being created by passing trains should be kept to a minimum through proper right-of-way grooming of dead and dry weeds and combustibles. Irrespective of this we find that, if the rear train crew are relocated to the locomotive cab, fires created by a passing train would not be as readily detected as they may be now.

D. Blocking of Emergency Vehicles at Crossings

Current trains can be up to 9,000 feet long and, in some situations, when stopped may block more than one road crossing. In certain locations, that blockage can result in the delay of fire department vehicles and ambulances from reaching emergency destinations. It is our view that the railways should not impose their presence on communities in this way; that is why the RTC requires railways not to wilfully block crossings in excess of 5 minutes by virtue of the provisions of UCOR 103 and the Railway Act. It appears, however, based on evidence heard during the regional hearings, that CN and CP employees may not presently be strictly adhering to these requirements.[9]

E. Protection of Adjacent Tracks

The protection of adjacent tracks under emergency train stops was a relatively frequent incident during the general train survey (23 to 29 times in 19 days). There is no question that conventional protection to the rear of an emergency-stopped train could not be as quickly facilitated with the rear train crew relocated to the cab of the locomotive. A new type of protection system would have to be employed if the additional risk of protection delay is to be avoided. This, however, is a matter that will be handled when dealing with UCOR 102 later.

F. Long Reverse Moves

During the general train survey there was a relatively large number of instances when long reverse moves were required (72 to 94 times in 19 days). There clearly would not be any additional risk in reverse moves if the provisions of UCOR 103, paragraphs 1 and 2 are adhered to. This issue will therefore be handled when that Rule is discussed later.

G. Rear Crew Assistance

Much evidence was given on how rear train crew provide assistance quickly to accident victims who could not be assisted as fast, or at all, by those in the locomotive cab. To the extent that this occurs, there is no question that the relocation of the rear train crew to the locomotive cab may delay or even eliminate such assistance. However, for reasons previously noted concerning public interest and railway obligations, we find that this potential loss of the assistance now provided by the rear train crew is not a railway obligation that we are prepared to require.

H. Loss of Head End Braking Capability

Although rare, the braking capability from the locomotive cab can be impaired, requiring the application of an emergency brake from the rear of the train. The relocation of the rear train crew to the locomotive cab and the replacement of the caboose with the Digitair II ETIS would not, however, increase the risk of this event. This is because the Digitair II has the rear train emergency brake option which, if the batteries are charged, will perform the same function as a rear train crew would in the event that there is a need for the application of an emergency brake from the rear due to incapacity of the braking functions in the locomotive cab. We therefore find that the relocation of the rear train crew would not increase the risks or consequences of a failure of the braking system from the locomotive cab.

I. Number 2 Air Brake Tests

There was much evidence concerning the appropriateness of using the ETIS to perform a No. 2 Air Brake Test. The major concern here is that the rear car brake shoes cannot be seen to apply and release if the rear train crew are relocated to the locomotive cab. As noted earlier, the principal purpose of the No. 2 Air Brake Test is to ensure air brake pipe continuity — not to test whether or not the brakes on the last car of the train are properly functioning. We therefore find that the proper use of the ETIS, to test for air brake pipe continuity, will not increase the risk of improper or malfunctioning air brakes, as the No. 2 Air Brake Test could be properly performed without verification that the brake shoes on the rear car have applied and released.

J. Visual Indications from Public and Wayside Employees

There is no question that, if the rear train crews are relocated to the locomotive cabs, they will no longer be able to see people giving indications of dangerous conditions on their train. Wayside employees would, however, contact the crew in the locomotive cab by hand-held radio rather than hand signals if the train were cabooseless. We therefore find that the relocation of the rear train crew to the locomotive cab would eliminate the possibility of the public indicating to the train crew a dangerous condition they may have observed when the train passed. We consider the importance of this risk to be of marginal significance.

K. Use of Caboose Radio

During the general train survey, incidents were reported where the head end radios failed and the caboose radio had therefore to be used. We understand that, if the rear train crew were relocated to the locomotive cab, the conductor's portable radio would be located in the locomotive cab as well. There would therefore be no reduction in the availability of radios on the train. It would however be true that, in the event of a head-on collision between two cabooseless trains, there is a chance that all radios

on both trains could be rendered inoperable. Presuming there was a survivor to such an incident, there could be no ready means to contact the dispatcher if the collision resulted in the destruction of all radio units. This could lead to delays in receiving assistance and to delays in notifying the public of possible hazards due to dangerous commodity leaks, if any. Also, additional risks would arise from the relocation of the rear train crew to the locomotive cab in respect of delays occasioned by loss of radio equipment in a head-on collision, particularly if dangerous goods were involved. Even so, we find that the chance of the circumstances occurring that could result in the failure of all radios is so remote as to present little if any additional risk.

L. Engine Failure During Inclement Weather in Remote Locations

There is no question that the present day caboose offers convenient and relatively comfortable accommodation and protection from a harsh environment. It is also possible for an engine to fail in remote areas during winter where there are no dwellings within a reasonable distance. Under those conditions it is very likely that the train crew would seek shelter in the caboose until assistance arrived as a result of a radio call to the dispatcher. If the rear train crew were relocated to the locomotive cab and the caboose were replaced with an ETIS, the crew in those circumstances would have to remain in the cab or cabs of the locomotives on the train. If there are multiple units on the train it would be very unlikely that all would fail at the same time and therefore there would be no particular problem, save for inconvenience. Even if there was only one unit on the train, it is our opinion that, with the proper clothing the employee would have with him or her, and with the protection of the locomotive cab and the current ability to provide quick emergency assistance, there would be no significant danger. We therefore find that the relocation of the rear train crew to the locomotive cab would not pose any additional danger to crews operating trains in remote areas in winter where the locomotive fails.

M. Observation of Special Cars

On occasion there is a need to handle special cars such as extreme dimensional loads on freight trains. These types of cars often require continuous observation. If marshalled to the rear of a train it would be the rear train crew that would do the observing. We find, however, that if the rear train crew were relocated to the locomotive cab there would be no additional risks, as long as the special cars were marshalled to the front of the train and in sight of the train crew in the locomotive cab.

N. Trains Breaking Apart on Bridges

There are instances when a train comes apart on a bridge without walkways and where there may be a need to apply hand brakes on the rear portion of the train to prevent it from moving, as air brakes leak off. It has also been claimed that the application of the hand brakes in this situation cannot be accomplished by the head end crew. With this we find that, although a delay may be encountered, there would be no additional danger if the rear train crew were located in the locomotive cab, as long as the dispatcher was promptly notified of the situation by radio. Furthermore, we conclude that it would be a rare situation where access to the rear of the train would be delayed, for a period of time greater than the capability of the air brake system to hold the train, following an emergency application of the brakes.

O. HBDE Detector Performance Check

During the regional hearings it was raised that the relocation of the rear train crew to the locomotive cab would reduce the operating crews' ability to check wayside HBDE performance. We are of the opinion that current HBDE installations are adequate and sufficiently reliable and inspected at adequate intervals.

P. Pull-By Inspection Quality

It was alleged during the regional hearings that the quality of the pull-by inspection would be reduced in a cabooseless operation since it would be the disembarking crew that would perform the pull-by, and not the embarking crew.[10] The implication is that the disembarking crew has no vested interest in ensuring the pull-by is done well and that the train is as safe as possible. We cannot accept such a suggestion. We believe that the employee should have sufficient integrity to do the job assigned. Furthermore, we have every belief that railway employees are concerned with the safety of their colleagues and would do the best job possible even though they would not ride the train they inspect. Indeed, this has been the case with carmen. We therefore find that the relocation of the rear train crew to the locomotive cab would not reduce the quality of the pull-by inspection.

Q. Train Documentation

Significant evidence was given during the hearing and at regional hearings concerning the possibility of train documentation (train consists, way bills and Emergency Response Forms) being lost in the event of a head-on collision involving a cabooseless train, and the associated risks if a dangerous goods leak ensues.[11] At present, it is also possible for the train documents to be destroyed in the event of a rear end collision. The risk of that occurring is extremely remote as is the risk of front end collisions that could result in the loss of documents in the cab. The question therefore is whether or not there is a greater chance of a head-on collision or a rear end collision where the severity of the collision is such that documents would be lost. We have difficulty in determining whether one is more probable than the other. Nevertheless, we were also made well aware of the existence of train consist and hazard information data in a centralized computer that, in the event of a dangerous goods leak, would be readily available by radio or telephone to/from railway employees or local fire departments or police officials. We therefore find that there would not be any significant additional risk to the public or to employees in respect of

the potential loss of train documents located in the cab of a locomotive as compared to being located in the caboose of a train.

R. Space Sufficiency in Locomotive Cab

During the regional hearings it was emphasized that there is not sufficient room in the locomotive cab to house the rear train crew and, as a result, safety will be reduced.[12] We are of the opinion that a three-man crew in the locomotive is safe and not overcrowded. When the crew consists of more than three, at the conductor's direction the additional crew member(s) may be located on the second unit of the locomotive consist.

S. Locomotive Engineer's Visibility

During the regional hearings it was noted that if conductors were located in the locomotive cab they would require light to perform paperwork whereas the locomotive engineer requires the locomotive cab to be dark at night to maximize his ability to see; because of this safety will be reduced by relocating the rear train crew to the locomotive cab. We consider this to be a very practical point and, indeed, we agree that the crew's visibility would be reduced by cab light just as the ability to inspect a train from the cupola of the caboose is reduced by interior light. Although we agree that this is a safety factor, it is one that can be easily resolved.

T. Distance Measuring Device (DMD)

Throughout the hearing there remained a recurring matter of whether the DMD is sufficiently accurate to be used in various train operations. During the regional hearings it was noted that it is possible for a train crew to be given a train consist that is incorrect. Thus, the locomotive engineer would not be accurately aware how long his or her train was. This, in combination with the inaccuracy of the DMD, was alleged by certain witnesses in opposition to the application to result in additional risks that could result in serious collisions. We find, however, that we cannot conceive of a situation where this would be true. In the application of UCOR

Rule 103, in the event of a reverse movement, a member of the crew must be on the leading car in a position to control such movement including the handling of main track switches or, if necessary, cutting the train at a public crossing. We also find that there is adequate protection at siding ends in CTC such that a run-out of slack would be identified by the track circuitry so that no unnoticed fouling of the main track would occur. We therefore find that the possibility of an inaccurate train consist of a cabooseless train presents no serious additional risk if the rear train crew were relocated in the locomotive cab.

U. Locomotive Cab Conditions

During the regional hearings it was alleged that the locomotive cabs are currently dirty and without adequate toilet facilities — a condition that would worsen if the rear train crew were relocated to the locomotive cab.[13] The implication was that this condition may cause a reduction in safety. Although the suitability of working conditions is of general concern to the RTC, as a matter of occupational health and safety, we do not consider the adequacy of sanitary facilities or the cleanliness thereof a matter that directly or indirectly would alter the current level of operational safety. We therefore find that this issue is not relevant to the matter at hand but is more appropriate for management-labour arrangements as outlined in the Canada Labour Code, Part IV.

V. Post-Accident Protection and Remedial Measures

Throughout the hearings, a recurring concern arose — particularly among those having interests pertaining to communities along railway tracks. That concern was that the relocation of the rear train crew to the locomotive cab would result in increased risks after a derailment or collision involving the release of a dangerous commodity. This concern was an issue with small communities because of the inability of the community to handle the aftermath of such an event and, with the larger municipalities, because of the difficulty of accomplishing an evacuation. It was alleged that the conductor would be readily and quickly available to the fire department and police, and

to immediately notify officials of the status of events from the perspective of the rear of the train — something that could not be accomplished if all crew were in the locomotive. We find this to be a matter of fact and of particular consequence if the derailment were located near the rear of the train. It is, however, a matter mainly of a slight delay in positioning of crew after a derailment and not, in our opinion, an additional risk of major significance.

W. Delay

There are instances when the crew must conduct repairs on a train necessitating delays; if such repairs are located at the rear portion of the train, the front crew would have to walk back to perform this function and this could cause a delay. We do not find that such delays are safety concerns but would simply inconvenience the railways, and the economic consequences of such delays are not a consideration in the operation of cabooseless freight trains.

X. Reduced Maintenance and Inspections

It was alleged during the regional hearings that, because of reductions over the past years in the number of maintenance employees and the amount of inspections conducted on the railways, the role of the conductor at the rear of the train becomes more significant.[14] We do not agree with this view because, even though employment has been reduced in these areas, the number of accidents over the same years has also decreased. Furthermore, the current level of safety is that which is to be maintained with cabooseless operations, and that level of safety is dictated by the current levels of employment in the areas of maintenance and inspection. There is no reason to assume that the current levels are too low.

In consideration of the above, and in respect of the consequences of relocating the rear train crew to the locomotive cab, we conclude in summary that:

1. The chance of detecting a leak of a dangerous commodity from cars located within sight of the last car of a train en route would not change if no dangerous commodity loads were marshalled within sight of the end of a cabooseless train.

2. The risk of a train colliding with a car at a crossing at grade would not increase as long as a crew member is positioned at the end of a train, in reverse movements towards a crossing, in accordance with the requirements of UCOR Rule 103.

3. The chance of a prolonged blocking of a crossing could theoretically be increased but the provisions of UCOR Rule 103 and the Railway Act restrict crossing blockage to 5 minutes.

4. Fire created by the passing of a train may not be detected as quickly, but this is not considered a significant change in risk.

5. Assistance to occupants of vehicles which have collided with the side of a train may be delayed and possibly eliminated in some cases; however, the additional equipment and assistance from the crew in the locomotive cab may reduce the consequences of collisions near the front of the train.

6. The risks associated with front end brake failure would not increase.

7. The No. 2 Air Brake Test can be adequately conducted without any additional risk with the aid of the ETIS and without visual confirmation of the application and release of the brake shoes on the last car of a train.

8. Visual indications received from the public of dangerous conditions on passing trains may be delayed and, in some circumstances, eliminated but would not result in any significant additional risks.

9. Visual indications from wayside employees concerning dangerous conditions on passing trains would be eliminated, but replaced by radio communications with no additional risk.

10. The risk of all radios on a train becoming inoperative at the same time as a result of a head-on collision would be increased because there would be no radio in the caboose, but the record shows that the chance of a head-on collision resulting in the destruction of all radios is extremely remote.

11. There would be no significant danger to the crew arising from the failure of an engine in remote locations during winter as long as radios are functioning and the crew properly clothed.

12. There would be no additional risks associated with the observation of special cars if such cars are marshalled within sight of the lead locomotive.

13. There would be a delay in applying hand brakes to the rear portion of a train when it breaks apart on

a bridge with no cat walks, but the emergency brake application would remain effective for sufficient time to permit the securing of the rear portion of the train without mishap.

14. There would be no change in quality of the pull-by inspections.

15. There would be no significant change in the risk of train documentation being lost, but the consequences of a loss, given access to central computerized consist and hazard information, is minimal.

16. The availability of space in the cab is considered safe and adequate for a crew of three and where more space is required additional crew members or other employees riding on freight trains may be accommodated in the trailing units of the locomotive consist, and in all cases General Order No. O-18 should be complied with.

17. The need for light for the conductor to do paper-work by night may reduce the locomotive engineer's ability to see at night unless a remedial measure is taken.

18. The possibility of an incorrect consist will not increase risks of collision or other accidents — although it may result in train delay.

19. The cleanliness and sanitary conditions within a cab are not a matter of operational safety but of convenience and occupational health and safety and are therefore not a direct issue pertaining to the safety aspects of the applications.

20. The conductors may be delayed slightly in their duties arising from a dangerous commodity leak from a car to the rear of a train as a result of a derailment; however, this delay is not considered to add significantly to public hazards, particularly if dangerous goods were not marshalled within sight of the rear of the train.

21. The delays arising from the crew having to conduct repairs at the rear of the train may increase; however, it is not a safety matter, but rather an inconvenience to the railways.

22. The current level of employment in the areas of maintenance and inspection is considered adequate to handle the requirements of a 100% cabooseless operation.

5.7 Applications and Other Related Rules

General

Many of the findings and conclusions on the safety consequences arising from the possible transition to cabooseless operations are related to the provisions of the Uniform Code of Operating Rules. The applications themselves are simply for changes to or relief from those Rules. The evidence pertaining to the Rules that relate to cabooseless operations has been described in detail earlier. Herein, we will make our findings on the applications. In addition, we will make our findings on those existing Rules that pertain to rear crew functions but were not part of the railways' applications for change.

The Applications

Canadian National Railway Company has applied for relief from Rule 90A of the Canadian Transport Commission's Regulations No. 0-8, Uniform Code of Operating Rules, C.R.C. 1978, C. 1175. Canadian Pacific Limited has applied for approval of its suggested amendments to Rules 19, 19A, 90A and 102 of those same regulations.

Rule 90A

Rule 90A is common to both applications. This Rule requires:

1. on freight, mixed, and work trains in motion between stations, conductors and enginemen will see that trainmen are at the front and rear of trains in position to observe the safe operation of trains;

2. when practicable, exchange signals with wayside employees when approaching and passing stations;

3. approaching junctions, railway crossings at grade, drawbridges, points where trains may be required to stop, where trains are met or passed, and at a safe distance before descending heavy grades or at any point where failure of the brakes may be attended with hazard, a trainman must be within convenient access of the emergency valve.

With respect to item 3 above, we are convinced that the Digitair II rear emergency brake option is sufficiently reliable to equate to the requirement that a trainman must be within convenient access to the emergency valve. This part of Rule 90A is therefore accommodated by the requirement that the ETIS on cabooseless trains has the emergency brake option installed and functioning.

With respect to item 2 above, we are convinced that the availability of reliable fixed and portable radios facilitates the exchange of information with employees at wayside without difficulty when approaching, passing, and after having passed stations or wayside maintenance crews. The intent of item 2 of the Rule can therefore be met by a cabooseless train crew.

Item 1 provided the most contentious area of concern at the hearing. We have dealt with the consequences of relocating the rear train crew to the locomotive cab in previous findings. That discussion is very germane to the ability of the train crew to adhere to the intent of this part of the Rule. As implied earlier, the consequences of not having a rear crew located in the caboose observing the operation of the train are as follows:

1. The risk of derailment due to track defects, sticking brakes, and bearing failure that could be seen from the train rear will marginally increase.

2. The risk of derailment due to dragging equipment, tell-tale marks of which could be seen from the train rear, and due to improperly loaded cars that can be seen from the rear of the train will increase.

3. The risk of derailment due to employee error will decrease.

4. The severity of derailments arising from 1, 2 and 3 above would involve only property damage if there were no dangerous goods leaks involved and there would be less risk of employee injury due to derailments.

5. The risk of collision due to employee error will decrease.

6. The risk of crossing accidents will not increase; however, the consequences of vehicle-to-train collisions may increase compared to the consequences of train-to-vehicle collisions, which may decrease.

7. The chance of detecting a dangerous commodity leak in a car that could be seen from the rear of a train would decrease.

8. The speed of detecting a wayside fire caused by a passing train would decrease.

9. The speed with which train crews would receive warnings from the public as to dangerous conditions on a train would decrease.

10. There would be additional risks arising from the marshalling of special cars within sight of the rear of a cabooseless train.

11. The consequences of a derailment involving a dangerous goods leak will increase — if the leak is located at the rear of the train.

12. The chance of injury to the rear crew will decrease.

There are both positive consequences (items 3, 5, 12) and negative consequences (items 1, 2, 4, 6, 7, 8, 9, 10, 11) to the possible relocation of the rear train crew to the locomotive cab. It is our opinion that the net change in risk is negative. Therefore a granting of what essentially constitutes an exemption from Rule 90A cannot be given without conditions, as long as conditions can be found that would compensate for the net additional risk.

Rule 90A Conditions

Items 4, 7 and 11 involve dangerous goods — a matter that was frequently expressed as a major concern to most intervenors in this case. If it was required that all dangerous goods cars on cabooseless trains were restricted from being marshalled within sight of the rear car of the train, the additional risks of item 7 would be eliminated and the additional risks of items 4 and 11 would be substantially reduced and would be further reduced if the dangerous goods cars were located as close as possible to the front end. Moreover the severity of accidents related to items 1 and 2 would be reduced.

Item 10 poses an additional risk that could be eliminated by simply requiring that all special cars such as extreme dimensional loads and loads that are prone to shifting be marshalled within sight of the locomotive on cabooseless trains.

Additional risks in item 1 could be reduced by locating a hot wheel detector at the first outbound hot box and dragging equipment detector from each yard.

All things considered, if the above mentioned conditions were met, it is our opinion that the net additional risks of granting an exemption from Rule 90A would not be significant and may even result in a marginal improvement to safety.

Rule 102

According to CN,[15] Rule 102 will be adhered to by them if they are permitted to operate with cabooseless trains, through the application of an operating instruction which prohibits the overtake of a moving cabooseless train by another train. In particular, CN in their evidence proposed to provide this protection:

1. In CTC territory, by the dispatcher controlling block signals.

2. In ABS territory, by ensuring that neither a cabooseless train nor any other train moving in the same direction is operated against the current of traffic in such a manner or at a location that entails passing a cabooseless train which is in motion on an adjacent track.

3. In train order or MBS territory, by ensuring cabooseless trains have positive rear-end protection.

4. When adjacent tracks belong to another railway, CN had no ready solution.

CP on the other hand proposed a wording change to Rule 102 as noted on pages 46-47 hereof.

Certainly, if the proposal made by CN constitutes assurance that a train of any kind would not be able to overtake a cabooseless train in motion, or when stopped, then there would be no additional risk and the provisions of Rule 102 would only apply to the front end of the train and trains approaching the locomotive in opposing directions. However, our reading of CN's proposal leads us to conclude that the proposed protection to the rear is not so stringent. The overtake of a moving cabooseless train does not literally prevent the overtake of a train stopped for emergency purposes. Nor is it clear how a train of a different company operating on its own adjacent track would necessarily provide such train movement restriction.

The evidence on this indicates that CN has an emergency radio call procedure (CN Form 696, Section 3.4), described on pages 47-48 hereof, which is in place because CN felt that Rule 102 protection of adjacent tracks is not now always possible in time to ensure full protection.

CP proposed that this Rule be reworded, essentially to replace current rear end protection practices with an emergency radio call procedure similar to that which CN has authorized.

All things considered, we are of the opinion that the use of a radio emergency call is a reasonable alternative to current rear train protection practices up until the time that UCOR 102 can be complied with as stated. In this respect, we do not object to CP employing an emergency radio call procedure in its Form CS44 similar to that employed by CN in its Form 696. We do not, however, consider such an emergency radio practice as a replacement for the provisions of Rule 102. Because the relocation of the rear train crew to the locomotive cab in a cabooseless train will substantially reduce the time within which Rule 102 can be fully complied with, if the intent of the applications are to be permitted, we believe that an emergency radio procedure should be mandatory. In this respect, the mandatory emergency radio procedure should contain the following elements:

1. The emergency radio procedure should be immediately carried out by the locomotive engineer or, in the case of his incapacity, by any other crew member, when a cabooseless train is disabled, or stopped suddenly by an emergency application of the air brakes or other causes.

2. The provisions of Rule 102 should be complied with irrespective of the implementation of emergency radio procedure, and should be done so with dispatch.

3. The emergency radio procedure should include:

- a radio broadcast on the end-to-end radio channel (frequency) in the form "*emergency, emergency, emergency train ____, mileage ____, subdivision _____*;

- other trains closing in on the emergency location must stop and then proceed at restricted speed until the designated route is known to be safe and clear;

- a subsequent radio broadcast to the dispatcher repeating the initial emergency message followed by provision of the details of the situation to the dispatcher;

- a radio call to all trains on adjacent tracks not to pass the emergency location until further advised and, in the case where the adjacent tracks are those of another company, the call shall be by telephone to the appropriate dispatcher of that company. In this latter respect, there is a need to have a direct dedicated emergency telephone line between dispatchers of companies having adjacent tracks to CN or CP.

If the emergency radio procedure is implemented, and Rule 102 is complied with immediately, we are of the opinion that no additional risks would result in respect of cabooseless trains in situations where Rule 102 would normally apply with a caboose.

Rules 19 and 19A

Rules 19 and 19A deal with rear train markers. A cabooseless train would not be equipped to display markers as prescribed by Rule 19. Rule 19A

would thus apply to cabooseless trains. In so far as the Digitair II which is equipped with a light, and that light could be red, a cabooseless train could comply with Rule 19A in CTC territory. However, Rule 19A requires that the light be white when the train is clear of the main track, except in CTC territory. In this latter respect, we conclude that there would be no additional risk if both CN and CP were given exemption from the provisions of Rules 19 and 19A in respect of cabooseless trains, but required to display to the rear by day a red reflectorized marker, and by night a red flashing light.

Other UCOR Rules

A number of UCOR Rules, other than those that are part of the railways' applications, have been identified previously in Chapter 2 as being potentially affected by a transition to cabooseless operation.

A number of Rules require the locomotive engineer to know the location of the last car on his train. For example: Rule 17 requires that the locomotive engineer know whether or not his train has stopped clear of the main track; Rule 43 requires that he know when his train has passed a green signal; Rule 98 requires that he know when his train has passed a particular point such as a junction, interlocked railway crossing or a draw-bridge, etc.; and Rule 103 requires that he know when his train has passed over a level crossing. These requirements are not as readily complied with if there is no caboose and the rear train crew is relocated in the locomotive cab. However, it is our belief that this problem is minor, and that any additional risk can be overcome through the use of a distance measuring device as a guideline to an experienced locomotive engineer. To further reduce additional risks, it is our conclusion that the addition of a distance tolerance of 3% or 30 feet in 1000 feet of train should be added to the distance required to locate the rear car of the train.

In addition to Rule 102, the application of Rule 35 may require protection of the train at both ends. In emergency situations such as may occur with Rule 35, we conclude that there would be no additional risk if the

emergency radio procedure outlined for Rule 102 was adhered to. In non-emergency situations, such as in Rules 104 and 86, while the crew member walks back to the locomotive after having lined the switch of a siding after his train has passed over it, the train while stopped on the main track should be protected by Form "U" train order in train order territory. It would be protected by signals in CTC territory and by a manual block clearance in MBS territory.

Rule 103 was the topic of considerable evidence, and it is our opinion that it should be closely adhered to at all times and in all situations to avoid the possibility of hindering the expeditious transit of road vehicles over public crossings at grade. Furthermore, when it is necessary to cut a train at a crossing to comply with Rule 103, a crew member should be dropped off at the crossing as the train passes over it to minimize the time taken to cut the train.

Rule 111, paragraph 1, requires in part that when other duties permit, trainmen at the rear of moving trains will be in position, on rear platform where provided, to observe the condition of equipment on passing trains. On cabooseless trains, the rear platform will not be provided as it is part of the caboose. Signals between crew members of moving trains as required by paragraph 2 of this Rule can be complied with by the use of portable radios.

Paragraph 3 of Rule 111 cannot be complied with, however, that being that the rear trainman must frequently look back to see if there is evidence of dragging equipment. We have considered the implications of this requirement previously. It is an additional risk associated with cabooseless train operations which we have considered to be compensated for by other factors. We therefore conclude that CN and CP should be exempted from the provisions of paragraph 3 in the case of a cabooseless train.

Paragraph 7 of Rule 221 requires that a train must not proceed without a clearance when the train order signal affecting it is in STOP or CAUTION indication while any portion of the train is passing the signal.

Since the entire crew in a caboose less operation will be located at the front of the train, operators must be instructed not to display the train order signal in STOP or CAUTION indication after the engine has passed the train order signal.

Railway Company Rules

Both CN and CP explained that they plan to revise their rules pertaining to those parts of the No. 2 and No. 3 Brake Tests that test for brake pipe continuity. As discussed earlier, we are of the opinion that continuity of the brake pipe can adequately be determined through the use of the ETIS pressure sensing transmission and display functions without actually seeing the brake shoes on the rear car applying and releasing. In this respect, and more specifically, we conclude that the wording of rules pertaining to the testing of air brake pipe continuity could be as follows:

> *"Evidence that the brake pipe pressure has reduced on the rear car of a train due to a full service brake application made on the locomotive and subsequent evidence that the brake pipe pressure on the rear car is rising, confirms that brake pipe continuity exists and can be taken as confirmation that the brakes on the last car have applied and released".*

If this rule is included in the company rules we conclude that no additional risk would result.

6.0 DECISION

The evidence in this Case has been voluminous and complex due, in part, to the Commission's insistence on a complete examination of all aspects of the Applications of the Railways to amend the Uniform Code of Operating Rules in a manner that will permit the operation of cabooseless freight trains.

Having required lengthy field and laboratory tests and having heard numerous witnesses for and against the applications at various places in all regions of Canada, we believe that the evidence before us is the best that could be adduced in the circumstances.

The central issue is whether or not the use of technology by the Railways has advanced sufficiently to permit the cabooses on freight trains to be removed and the rear crew to be relocated in the locomotive operating cab, without a reduction in the current level of safety.

Since the safety issue posed by the operation of cabooseless trains is one which involves an evaluation of things which are not presently in place, we believe that the evaluation cannot be done with the complete confidence that would be possible in evaluating that which has already taken place.

However, as our analysis of the evidence has indicated, we do not believe, as some have advocated, that a criminal standard of proof is necessary in deciding this Case whereby we must be satisfied beyond any doubt that the change to cabooseless operation will be completely free of the risk of otherwise preventable accidents.

We do believe, however, that having identified, through the hearing process, a number of areas where there may be increased risk by reason of the removal of the caboose and the rear crew members, that the extended use of technology and certain operating practices beyond that which the railways

have proposed, will adequately compensate for any additional risk that may occur.

We have seriously considered the assertion that the End-of-Train Information System cannot adequately replace the human sensory capabilities of a crew member at the end of a freight train and we agree.

The evidence also makes it clear, however, that the railways do not intend to rely solely on the ETIS to operate cabooseless trains.

There has indeed been a vast number of technological developments in the railway industry in the past two decades which were aimed at solving individual problems but which, collectively, have produced a much safer, more dependable, operation.

In this regard, we heard evidence of improved hot box, dragging equipment and hot wheel indicators, including the recent "talker" innovation, roller bearings and improved lubricants, better road bed, modern signal and communication systems making use of extended range radios, computer, micro-wave and micro-chip technology, larger capacity storage batteries, remote controlled switch heaters, improved braking systems and improved motive power and rolling stock design. All of these changes and improvements have not taken place overnight; the effects have been cumulative and have tended to impact on the traditional role of the caboose and its occupants over time.

Taking all of this into account, we are convinced that the railways have now reached a stage in the development of technology which permits the removal of cabooses and the relocation of the rear crew to the operating cab of the locomotive without overall additional risks to the safety of the employees and the public, providing certain conditions involving the use of modern technology and changes in operating practices, as outlined in the following Order, are met.

Our Decision, therefore, takes the form of RTC Order No. R-41300, which is attached.

John F. Walter
Chairman

Robert J. Orange
Commissioner

CANADIAN TRANSPORT COMMISSION
RAILWAY TRANSPORT COMMITTEE

ORDER NO.: R-41300

December 14,1987

IN THE MATTER OF an application filed by Canadian Pacific Limited, for approval of amendments to Rules 19, 19A, 90A and 102 of the Canadian Transport Commission's Regulations No. O-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175;

IN THE MATTER OF an application filed by the Canadian National Railway Company for relief from Rule 90A of the Canadian Transport Commission's Regulations No. O-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175;

IN THE MATTER OF tests, conducted to evaluate the reliability of the end-of-train unit and associated devices and to evaluate the risks associated with train operation without rear train crew, required by the Railway Transport Committee pursuant to its decision of September 16, 1985 which dealt with the matter of testing cabooseless trains.

File Nos. 4357R90-A.1
4357R90-A.2

WHEREAS pursuant to the provisions of Section 227 of the Railway Act, the Railway Transport Committee may make orders and regulations *"(1) generally providing for the protection of property, and the protection, safety, accommodation and comfort of the public and of the employees of the company, in the running and operation of trains and the speed thereof, or the use of engines, by the company on or in connection with the railway."*;

WHEREAS the Railway Transport Committee has heard lengthy and detailed evidence for and against the applications of Canadian Pacific Limited and Canadian National Railway Company, and with respect to field and laboratory tests on technical reliability and accuracy of the end-of-train information system, rear train crew surveys, and associated analyses and evaluations of the risks associated with caboose less trains;

WHEREAS the Railway Transport Committee finds that the end-of-train-information-system, referred to as the Digitair II, including the rear train emergency braking feature, with a red flashing marker light and with a distance measuring device where such is required, is sufficiently reliable and accurate to be employed on caboose less trains and to perform the functions for which it was designed;

WHEREAS the Railway Transport Committee finds that, subject to certain safeguards set forth in the operative part of this Order, Canadian Pacific Limited and Canadian National Railway Company may be granted the right to operate caboose less trains without a reduction in the level of safety now afforded to their employees, train passengers and the public;

THE RAILWAY TRANSPORT COMMITTEE HEREBY ORDERS THAT:

1. 0 Subject to Canadian Pacific Limited and Canadian National Railway Company compliance with the following conditions,

Canadian Pacific Limited and Canadian National Railway Company are hereby exempted, for purposes of operating cabooseless trains, from the provisions of Rule 90A of the Canadian Transport Commission's Regulations No. O-8, Uniform Code of Operating Rules, C.R.C. 1978, c. 1175 that require operating crew to be located at the rear of trains.

1. 1 A train may be operated without a caboose and with the rear crew located in the cabs of the lead locomotive consist provided the train is equipped with a Digitair II end-of-train-information-system with a rear train emergency braking feature and a red flashing marker light operated by an automatic light sensitive cell (switch), and with a distance measuring device where no other distance measuring device is installed on that train, or an equivalent end-of-train information system approved by the Railway Transport Committee, that train hereinafter referred to as a cabooseless train.

1. 2 A conductor on a cabooseless train shall be stationed in the operating cab of the lead locomotive.

1. 3 No cabooseless train shall be operated for a distance in excess of 60 miles without having passed an operational hot box and dragging equipment detector or without having been inspected on each side of the train by employees referred to in item 1.11, or without having been stopped and inspected.

1. 4 Prior to the operation of any cabooseless train all gateway hot box and dragging equipment detectors shall be equipped with hot wheel detectors.

1. 5 Prior to the operation of any cabooseless train and within six (6) months of the date of this Order, Canadian Pacific Limited and Canadian National Railway Company shall file a plan with the Railway Transport Committee for the expeditious equipping

of all hot box and dragging equipment detectors with hot wheel detectors.

1. 6 Except as provided in 1.8 and subject to marshalling rules that may be in effect, a cabooseless train handling cars containing dangerous commodities shall not have such cars marshalled within 2,000 feet of the rear of that train where that train is more than 4,000 feet in length.

1. 7 Except as provided in 1.8 and subject to marshalling rules that may be in effect, a cabooseless train that is less than 4,000 feet in length shall be marshalled so that cars containing dangerous commodities are located only within 2,000 feet of the lead locomotive.

1. 8 Subject to marshalling rules that may be in effect, cars containing dangerous commodities may be marshalled in any location on a cabooseless train if located behind cars that are all equipped with roller bearings.

1. 9 All dimensional loads that would normally be marshalled so that they could be seen by the train crew, cars with loads that are prone to shifting and special loads that should be observed while en route, shall be marshalled as close as possible to the lead locomotive, but shall not be marshalled more than 2,000 feet from the lead locomotive.

1.10 Each trainman and conductor on a cabooseless train shall be provided with an operational portable two-way radio before leaving a crew change off point.

1.11 Each section gang, extra gang, signal gang, welding gang, road master, assistant roadmaster, operator, track patrol employee and other employees or groups of employees, where assigned duties along the right of way where a cabooseless train

may be moving and where that passing train can be observed, shall be provided with or have immediate access to an operational portable two-way radio capable of communicating with the crew of that passing train.

1.12 Where two or more employees, referred to in 1.11, are in proximity to each other on the right of way where a cabooseless train may be moving, and when safe to do so, an inspection for defects and dangerous conditions of passing trains shall be accomplished by one employee positioned on each side of the passing train and they shall report by radio any defects or dangerous conditions to the crew of the passing train upon completion of the inspection. Where only one employee referred to in 1.11 is in proximity to the right of way where a cabooseless train may be moving, that employee shall also inspect passing trains and shall report by radio any defects or dangerous conditions to the crew of that train upon completion of inspection.

1.13 Prior to the operation of cabooseless trains, special radio instructions to be used with, but not necessarily restricted to use with Rule 102 of the Uniform Code of Operating Rules, to warn other trains and the dispatcher of emergency conditions pertaining to the operation of or condition of a cabooseless train, shall be filed with the Railway Transport Committee by Canadian Pacific Limited and Canadian National Railway Company and must be approved by the Railway Transport Committee.

1.14 Appropriate seating accommodations in the lead locomotive cab of a cabooseless train shall be provided to the conductor as well as to at least one trainman. Where such seating for all crew members cannot be provided in the lead locomotive of a cabooseless train, a trailing locomotive unit shall also be so equipped and be used to accommodate trainmen or other employees required to ride that cabooseless train. All such seating

accommodations shall comply with Section 10.15 of Part X of the On Board Trains Occupational Safety and Health Regulations, made pursuant to Part IV of the Canada Labour Code.

1.15 The lead locomotive cab of a cabooseless train shall be equipped with a fold-out or permanent table for the conductor to perform his work and with indirect lighting that will not require the cab ceiling light to be used for the conductor to read documents or perform paper work, and that will not interfere with the vision of the other crew members in that cab at night.

1.16 The sanitary facilities in all occupied locomotive cabs of a cabooseless train shall be provided in compliance with the provisions of Part VI of the On Board Trains Occupational Safety and Health Regulations made pursuant to Part IV of the Canada Labour Code.

1.17 At least one locomotive in the lead locomotive consist on a cabooseless train shall be equipped with first aid equipment, including a stretcher, placed in a storage space that will preserve the integrity of that equipment and that will not interfere with the conduct of duties by the crew members in that locomotive consist.

1.18 A cabooseless train shall not be permitted to leave a crew change point unless all components of the end-of-train-system are properly functioning.

1.19 Where any component or function of an end-of-train-information-system fails en route, the cabooseless train shall proceed to the next crew change point at a speed not exceeding 25 mph.

1.20 Prior to the operation of cabooseless trains, and for purposes of 1.18 and 1.19, Canadian Pacific Limited and Canadian

National Railway Company shall define a failure of a component or function of an end-of-train-information-system in a special instruction or standard filed with and approved by the Railway Transport Committee.

1.21 Where a cabooseless train is stopped and is about to be passed by another train, two crew members from the stopped train shall respectively position themselves on each side of the track on which the passing train is moving, when safe to do so, and they shall inspect that passing train and shall report by radio any defects or dangerous conditions to the crew of the passing train upon completion of the inspection.

1.22 On arrival at crew change points, two members of the inbound crew of a cabooseless train shall respectively position themselves on each side of the track on which that cabooseless train is moving and shall inspect that train while moving outbound for defects and dangerous conditions and shall report by radio any defects or dangerous conditions to the crew of that outbound train upon completion of the inspection.

1.23 For purposes of conducting a No. 2 and a No. 3 air brake test on a cabooseless train, and subject to 1.24 and 1.25, the end-of-train-information-system shall be used to verify that brake pipe continuity exists throughout the train and to determine that the air brake system is responding properly to the application and release of air brakes on the last car of the train.

1.24 An indication on the display unit of the end-of-train-information-system in the locomotive cab of 60 psi or more brake pipe pressure sensed at the rear car shall be considered to be an indication that the brake system on a cabooseless train is sufficiently charged for conducting a No. 2 or No. 3 air brake test, if all other requirements for those air brake tests are met.

1.25 During a No. 2 or No. 3 air brake test on a caboose less train and following a full service brake application and release, respective indications of the display unit in the locomotive cab that the brake pipe pressure has decreased and increased at the rear car shall be considered to be a verification that the air brake system has initiated an application and a release of brakes and shall be considered to confirm that the brakes on the rear car have applied and released.

1.26 The locomotive engineer or the conductor of a cabooseless train shall be provided with a train consist printout for that train which shall indicate the total length of that train in feet with slack fully extended.

1.27 A means to calibrate the distance measuring device, such as a measured distance, on a cabooseless train shall be provided at each crew change off point where a cabooseless train may be operated so that, where necessary, that device on an outbound cabooseless train may be calibrated.

1.28 In accordance with the requirements of Rule 103 of the Uniform Code of Operating Rules, a cabooseless train shall not be operated in reverse until an employee positions himself on the leading car of the movement.

1.29 Prior to the operation of cabooseless trains, where rights of way of two railways abut one another and to the extent that there may be danger of cars from one railway fouling the track of another railway as a result of a derailment, a dedicated emergency telephone system shall be installed between the dispatchers having responsibility for the territory wherein those abutting rights of way exist and such telephone systems shall be used in emergencies such as may require compliance with Rule 102 of the Uniform Code of Operating Rules.

1.30 Canadian Pacific Limited and Canadian National Railway Company must take every precaution to avoid the wilful blocking of a level crossing by a cabooseless train and, where possible, work shall be planned in advance to permit that train to stop clear of any crossing or, where possible, that train shall be limited in length to permit it to be stored between crossings while switching operations are carried out.

1.31 Prior to the operation of cabooseless trains, special instructions shall be issued by Canadian Pacific Limited and Canadian National Railway Company which require operating crews to reduce to slow speed, as defined in the Uniform Code of Operating Rules, to observe the position of switch points before making a facing point move over spring switches which are not protected by a signal system.

1.32 A cabooseless train operated outside Automatic Block Signal and Centralized Traffic Control territories must be provided written positive relief from the requirement to provide Rule 99 Uniform Code of Operating Rules flag protection to the rear.

1.33 Thirty (30) days prior to the operation of cabooseless trains, Canadian Pacific Limited and Canadian National Railway Company shall file with the Railway Transport Committee standards applicable to the specific duties that may be assigned to employees required to install, service, or use an end-of-train-information-system. Such employees shall be trained and qualified under those standards prior to being assigned such duties.

1.34 Each operating crew member shall be trained and qualified with respect to the provisions of this Order and standards and special instructions arising from this Order prior to being assigned as crew on a cabooseless train.

1.35 Any employee, other than mentioned in 1.33 and 1.34 who may be assigned duties in respect of the operation of a cabooseless train or with responsibilities related thereto shall be trained and qualified with respect to the provisions of this Order prior to the assignment of those duties.

2. 0 Canadian pacific Limited and Canadian National Railway Company are hereby exempted, for purposes of operating cabooseless trains, from the provisions of Rule 19 of the Canadian Transport Commission's Regulations No. O-8, Uniform Code of Operating Rules, C.R.C. 1978, C. 1175 that require when a train is equipped, to display a single flashing type marker. It will display flashing green to the rear when that train is clear of the main track to be passed by another train.

3. 0 Any accident or incident reportable to the Railway Transport Committee shall specify whether or not the train or trains involved were operated with or without a caboose.

Signed this 14th day of December 1987.

John O'Hara
Secretary
Railway Transport Committee

ENDNOTES

Chapter 1

1. Railway Transport Committee Decision in the matter of applications filed by Canadian Pacific Limited and the Canadian National Railway Company pertaining to the operation and testing of cabooseless trains, September 1985.
2. Ibid.
3. Exhibit CTC-4.

Chapter 2

1. Exhibits CN-1 and CP-1.
2. Ibid.
3. Exhibit CRLA/UTU-112.
4. Ibid.
5. Ibid.
6. Exhibits CN-1 and CP-1.
7. Exhibit CRLA/UTU-112, p. 25.
8. Exhibits CN-1 and CP-1.
9. Exhibit CRLA/UTU-112.
10. Exhibits CN-1 and CP-1.
11. Ibid.
12. Ibid.
13. Ibid.
14. Exhibit CRLA/UTU-112, p. 75.
15. Exhibits CN-1 and CP-1.
16. Transcript Vol. 3, p. 405.
17. Ibid., p. 499.
18. Transcript Vol. 9, p. 1526.

19. Exhibits CN-1 and CP-1.
20. Exhibit CRLA/UTU-112, p. 52.
21. Ibid., p. 54.
22. Exhibit CRLA/UTU-112.
23. Exhibits CN-1 and CP-1.
24. Ibid.
25. Exhibit CN-1, p. 55.
26. Exhibit CRLA/UTU-112.
27. Exhibit CN-1, p. 46.
28. Exhibit CN-1, pp. 38-39.
29. Exhibits CN-1 and CP-1.
30. Ibid.
31. Exhibit CN-1, p. 41.
32. Exhibit CP-1, p. 17.
33. Exhibit CN-1, p. 42.
34. Exhibit CRLA/UTU-112, p. 24.
35. Exhibit CRLA/UTU-112.
36. Exhibits CN-1 and CP-1.
37. Exhibit CN-1, p. 20.
38. Exhibit CP-1, p. 33.
39. Exhibit CN-1, p. 20.
40. Ibid., p. 15.
41. Exhibit CP-1, p. 24.
42. Exhibit CN-1, pp. 16-18.
43. Exhibit CP-1, p. 28.
44. Exhibit CN-1, p. 10.
45. Exhibit CP-1, p. 28.

46. Ibid., p. 29.
47. Federal Register Vol. 51, No. 132, p. 25185.
48. Exhibit CP-1, p. 31.
49. Exhibit CN-4, p. 1.
50. Exhibit CN-5, p. 17.
51. Ibid., p. 3.
52. Ibid., p. 4.
53. Ibid., p. 18.
54. Transcript Vol. 4, p. 637.
55. Exhibit CN-4.
56. Ibid.
57. Ibid.
58. Ibid.
59. Exhibit CRLA/UTU-112, p. 18.
60. Ibid., pp. 17-18.
61. Exhibits CN-2, p. 2 and CP-18, pp. 39-44.
62. Exhibit CN-16, p. 15.
63. Exhibit CP-1, p. 38.
64. Exhibit CN-2, p. 3.
65. Exhibit CP-18, pp. 39-40, and CP-1, p. 37.
66. Exhibit CRLA/UTU-112, p. 16.
67. Exhibit CN-16, p. 10.
68. Ibid., p. 11.
69. Exhibit CN-10, pp. 4-5.
70. Exhibit CN-5, p. 5.
71. Exhibit CP-18, pp. 39-40.
72. Exhibit CRLA/UTU-112, p. 9.

73. Ibid., pp. 13-14.

74. Exhibits CN-16, p. 22, CP-18, p. 23, and CN-37, Table A.

75. Exhibit CN-16.

76. Exhibit CN-18.

77. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation 0-8.

78. Exhibit CN-1, p. 106.

79. Exhibit CP-1, p. 43.

80. Exhibit CRLA/UTU-112, pp. 60-61.

81. Ibid., p. 63.

82. Ibid., p. 64.

83. Ibid., pp. 66-68.

84. Ibid., p. 69.

85. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation 0-8.

86. Exhibit CP-1, p. 42.

87. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation 0-8.

88. Exhibit CP-1, pp. 42-43.

89. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation 0-8.

90. Exhibit CP-1, pp. 43-44.

91. Exhibit CN-1, p. iv.

92. Ibid.

93. Exhibit CN-1, p. 107.

94. Ibid., p. 108.

95. Ibid.

96. CN Final Argument, p. 50.

97. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation O-8.

98. Exhibit CN-1, pp. 75-76.

99. Transcript Vol. 51, p. 9888.

100. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation O-8.

101. Transcript Vol. 288, p. 5017.

102. Uniform Code of Operating Rules, Canadian Transport Commission, Regulation O-8.

103. Ibid.

104. Exhibit CTC-1C, pp. 8-9.

105. Transcript Vol. 31, p. 5307.

106. Transcript Vol. 9, pp. 1509-1521

107. Ibid.

108. Exhibit CP-1, pp. 44-45.

109. Ibid.

110. Exhibit CN-1, pp. 110-111.

111. Ibid, p. 112.

112. Exhibit CN-1, p. 116.

113. Exhibit CRLA/UTU-112, p. 10.

114. RTC Show Cause Hearing Decision on Railway Safety, September 30, 1981.

115. Exhibit CN-16, p. 28 and Exhibit CP-18, p. 43.

116. Exhibit CRLA/UTU-112, pp. 7-13.

117. Transcript Vol. 5, p. 762 and Vol. 11, p. 1904.

118. Exhibit CP-18, p. 43.

119. Transcript Vol. 24, p. 4173

120. Exhibit CP-18, p. 41.

121. Transcript p. 8851.

122. Exhibit CP-18, p. 42.

123. Exhibit CRLA/UTU-112, p. 25.

124. Ibid.

125. Ibid, pp. 25-26.

126. Ibid., p. 2.

127. Ibid.

128. Ibid, p. 10.

129. Ibid, p. 7.

130. Ibid, p. 12.

131. BCCC Final Argument

132. SKCC Final Argument

133. See note 1 chapter 1.

134. See note 1, Chapter 1.

135. Exhibit CRLA/UTU-112.

Chapter 3

1. Exhibit PI-76, p. 1.

2. Exhibit CN-8, p. 64.

3. Ibid.

4. Ibid.

5. Transcript p. 9898.

6. Exhibit CN-8, p. 68.

7. Ibid, p. 67.

8. Ibid, p. 68.

9. Ibid, p. 70.

10. Exhibit CTC-1C, p. 6.

11. Transcript, p. 9899.

12. Exhibit CN-8, pp. 73-74.
13. Ibid, p. 74.
14. Ibid, p. 75.
15. Ibid
16. Ibid
17. Ibid, p. 76.
18. Exhibit CTC-1C, p. 7.
19. Transcript, p. 9900.
20. UTU Final Argument, pp. 48, 53.
21. Exhibit CN-8, p. 78.
22. Transcript, p. 9898.
23. Exhibit CN-8, p. 110.
24. Trancript, p. 9901.
25. Exhibit CN-8, p. 177.
26. Ibid., p. 208.
27. Transcript, p. 9902.
28. Exhibit CN-8, p. 212.
29. Transcript, p. 9904.
30. Ibid.
31. Exhibit CTC-1D, p. 21.
32. Exhibit CRLA/UTU-112, p. 58.
33. Exhibit CTC-1D, p. 22.
34. Exhibit CN-9, p. 83.
35. CN Final Argument, p. 12.
36. Exhibit CN-9, p. 83.
37. Ibid.
38. CN Final Argument, p. 12.

39. Exhibit CN-9, p. 84.
40. Exhibit CRLA/UTU-112, p. 91.
41. CN Final Argument, p. 12.
42. Transcript Vol. 52, p. 9927.
43. Transcript Vol. 43, p. 8147.
44. Transcript Vol. 52, p. 9927.
45. Exhibit CN-9, p. 99.
46. Exhibit CRLA/UTU-112, p. 91.
47. Transcript Vol. 52, p. 9934.
48. Exhibit CN-9, p. 111.
49. CN Final Argument, p. 42.
50. UTU Final Argument, p. 55.
51. CN Final Argument, p. 43.
52. Exhibit CN-9, p. 93.
53. CN Final Argument, p. 20.
54. Transcript Vol. 52, p. 9931.
55. CN Final Argument, p. 44.
56. Exhibit CN-9, p. 90.
57. Transcript Vol. 52, p. 9929.
58. Transcript Vol. 43, p. 8190.
59. Transcript Vol. 52, p. 9930.
60. Exhibit CN-9, p. 104.
61. Transcript Vol. 52, p. 9938.
62. Exhibit CRLA/UTU-112, p. 91.
63. Exhibit CN-9, p. 91.
64. CN Final Argument, p. 17.
65. Transcript Vol. 27, p. 4734.

66. Exhibit CN-9, p. 47.
67. Ibid, pp. 52, 96.
68. Transcript Vol. 52, p. 9932.
69. Exhibit CN-9, p. 98.
70. Transcript Vol. 52, p. 9933.
71. Exhibit CRLA/UTU-112, p. 91.
72. Ibid.
73. Transcript Vol. 17, pp. 2910-2911 and CN Argument, p. 11.
74. Exhibit CN-9, p. 88.
75. Transcript Vol. 52, p. 9928.
76. Exhibit CN-9, p. 108.
77. Transcript Vol. 10, p. 1630.
78. Exhibit CN-9, p. 92 and Transcript Vol. 13, p. 2297.
79. Transcript Vol. 52, p. 9930
80. Ibid.
81. Exhibit CN-9, p. 97.
82. Transcript Vol. 52, p. 9932.
83. Exhibit CN-9, p. 106.
84. Transcript Vol. 52, p. 9939.
85. Ibid., p. 9940.
86. CN Final Argument, p. 28.
87. Exhibit CN-92, p. 89.
88. CN Final Argument, p. 15.
89. Exhibit CRLA/UTU-112, p. 91.
90. Transcript Vol. 52, p. 9929.
91. Exhibit CN-9, p. 107.
92. Transcript Vol. 52, p. 9940.

93. Transcript Vol. 19, p. 3268.
94. Transcript Vol. 52, pp. 9935-36.
95. CN Final Argument, p. 30.
96. Transcript Vol. 52, p. 9937.
97. CN Final Argument, p. 13.
98. Transcript Vol. 10, p. 1620.
99. Transcript Vol. 52, p. 9928.
100. CN Final Argument, p. 21.
101. Transcript Vol. 19, p. 3396.
102. Ibid.
103. Transcript Vol. 52, p. 9931.
104. CN Final Argument, p. 22.
105. Transcript Vol. 52, p. 9932.
106. Exhibit CN-9, p. 105.
107. CN Final Argument, p. 33.
108. Transcript Vol. 19, p. 3324.
109. Transcript Vol. 52, p. 9939.
110. CN Final Argument, p. 33.
111. Exhibit CRLA/UTU-112, p. 91.
112. Exhibit CN-9, p. 109.
113. Transcript Vol. 8, p. 1285.
114. Transcript Vol. 52, p. 9941.

Chapter 4

1. VIA Rail Canada, Final Argument .

Chapter 5

1. CN and CP Final Arguments.
2. CN Final Argument, p. 74.
3. Transcript, Vol. 5, p. 762 and Vol. 11, p. 1904.
4. Exhibits CN-2, p. 3 and CP-18, pp. 39-40.
5. See note 1, Chapter 1.
6. Exhibit CP-1.
7. Exhibit CRLA/UTU-112, Appendix B.
8. Ibid.
9. Transcript, Vol. 31, p. 5307.
10. Transcript, Vol. 38, p. 6944.
11. Transcript, Vol. 9, p. 1576.
12. Transcript, Vol. 33, p. 5870.
13. Ibid.
14. Transcript, Vol. 31, p. 5286.
15. CN Final Argument, p. 50.

APPENDICES

APPENDIX 1 APPEARANCES

COMMISSION STAFF

G. McLaughlin	Senior Advisor Office of the Chairman
J.H. Turner	Senior Advisor (Transportation) Operations Branch
R. Beckert	Senior Special Projects Officer Railway Economic Analysis Branch
L. Morin	Senior Transportation Economist Freight Studies Directorate Research Branch
T. Giroux P. Schnobb	Information Officers
E. Browne	Director, Communications
B.J. Ethier	Regional Director, Quebec Region
J.E. Fréchette	Regional Officer, Quebec Region
I.A. Nattress	Regional Director, Prairie Region
L.B. MacDonald	A/Regional Director, Ontario Region
V. Mann	Regional Transportation Officer, Atlantic Region
J.L. Gehring	Chief, Operations Safety, Alberta Region
J.J. Eisler	Regional Director, Pacific Region
J. McGown	Manager, Standards, Engineering Branch
D. Bois B.S. Henri	Hearing Process Officers
P. Leduc	Hearing Process Clerk

APPENDIX 1 - APPEARANCES

S. Pépin	Commission Counsel
P.J. Hassard	Commission Counsel
F.C. Hume	Solicitors
W.G. McMurray	Canadian Pacific Limited
M. Shannon	

Witnesses:

K.R. Peters
E.J. Bradley
J.K. Leslie
E.S. Cavanaugh
J.J. Murray
G.L. Gibson
P.R. Rudder
J.J. Fletcher
H.G. McGinn
C.M. Snavely, Jr.

S. Cantin	Solicitors
J. Luciani	Canadian National Railway Company

Witnesses:

R.W. Blanchette
J.C. Buckingham
J.W. Shuster
M.J. Kent
B. Buchanon
P.L. Ross
J.A. Johnson
K. Hepburn
A.W. Gibson
I.G. MacDonald
A.J. Wilson
G.H. Spence

E.G. Abbot	Solicitors
D. Watson	Canadian Railway Labour Association and United Transportation Union

Witnesses:

H. Kieferle
S. Keene
C.G. Hainsworth
R. Messier
R. Gaudreau
R. Courteau
D. McDuffe
M. Hone

APPENDIX 1 - APPEARANCES

D.J. Rosenbloom J. Aldridge	Solicitors, British Columbia Caboose Committee
	Witnesses: D. McFarlane G.W. Bigg N.E. Martin R.A. McDiarmid W.B. Oliver H.E. Nordgren P.A. Scarfo J.E. Loftus K.R. Nelson G. Adair J. Matonovich T.L. Erskine D.W. O'Donnell W. Romanow J. Stubberfield
Hon. R. Romanow E. Cline	Solicitors, Saskatchewan Keep the Caboose Committee
	Witnesses: I. Carlson B.J. Hannah W.F. Olijnyk R.B. Williams A. Klassen B. McLafferty B. Feldbruegge G.L. Unterschute D.A. Dueker R.H. Sarada E. Rathgeber J.D. Bell S.R. Greenwood L.A. Williams T.R. Hislop
H. Morrison H. Behrend J.H. Harvey	Metropolitan Toronto Rail Action Committee - M-TRAC
R.T. Beckwith D. Long	Canadian Industrial Transportation League

APPENDIX 1 - APPEARANCES

M. Shannon	Solicitor, Toronto Hamilton and Buffalo Railway Company
D. McDuffe	National Legislative Representative, United Transportation Union
M. Hone	Research Director, United Transportation Union
D. Weekes	Chairman, Saskatchewan Keep the Caboose Committee
W. Oliver	Executive Member, British Columbia Caboose Committee
J. H. Harvey	Director, M-TRAC
J.K. Allen	Solicitor, VIA Rail Canada Incorporated
R.L. Beaumier	Napierville Junction Railway Company
J.J. Cassidy	CSX Transportation
F.H. Christensen	British Columbia Ministry of Transportation & Highways
D. Watson	Caley and Wray
M. Eldridge	Vice-Chairman, Saskatchewan Keep the Caboose Committee
B. Gottselig	M.P., Moose Jaw
M.J. Parson W. Geiler	Brandon Caboose Committee
	Witnesses: F. Case R. Evans T. Smith N. Larry J. Albert
J. Klinski	Energy and Chemical Workers' Union Saskatchewan
D. Kincaid	City of Regina
W. Eberle	Grain Services Union

APPENDIX 1 - APPEARANCES

J. Ellerman	Saskatchewan Association of Fire Chiefs
E.B. Fletcher	Saskatchewan Professional Fire Fighters Association
R. Levee	Western Canadian Wheat Growers Association
B. Street R. Evans	Saskatchewan Association of Rural Municipalities
C.V. Besse	Mayor, Town of Biggar
J. Hunchuk	On her own behalf
G. Schmidt	Minister of Labour, Saskatchewan
A. Gallagher P. Murphy	Division 510, Brotherhood of Locomotive Engineers
L.A. Calvert	M.L.A. Moose Jaw South & New Democratic Party
N. Hunt	Saskatchewan Federation of Labour
	Witness:
	E. Boyle
D. Abel	Mayor, City of Melville & Transport 2000, Saskatchewan
A. Broda	Alderman, City of Melville & Transport 2000, Saskatchewan
J. Howard	Region 6, National Farmers' Union
G. Gelmich	Alderman, City of Estevan
L. Lewry	Mayor, City of Moose Jaw & Saskatchewan Urban Municipalities Association
B. Shields	Mayor, City of Weyburn
D. Bechamp R. Marsolais S. Couture	Comité législative du Québec pour les Travailleurs unis des transports

APPENDIX 1 - APPEARANCES

W. Gilmore	Local 618, United Transportation Union
B. Ruel M. Bertrand	Local 634, United Transportation Union
	Witness:
	P. Laurin
S. Leveille	Section locale 1924, Travailleurs unis des transports
D.G. Regan	Ronsco Supply Company Limited
J.Q. Nelham	National Steel Car Corporation
R. Lebel	Comité législative de la région de Québec, section locale 4, Travailleurs unis des transports, et Comité association sécurité ferroviaire pour la région de Québec
	Witnesses:
	R. Mongeon A. Couture A. Nadeau
G. Legault	Les Entreprises Ferroviaires du Canada
Y.B. Verner	Se représentant lui-même
M. Walker	Alderman, City of Toronto
	Witnesses:
	P. E. Wade R.P.R. Gaade
M. MacGee M. Stephens	National Council of Women of Canada
W.A. Smith	Local 344, United Transportation Union
	Witnesses:
	O.J. Foisy F.A. Henophy

APPENDIX 1 - APPEARANCES

C.W. Carew	Ontario Legislative Committee, Canadian Railway Labour Association
	Witnesses:
	P.J. Lemenchick A.F. McCahery
M.K. Hayes	United Transportation Union
	Witness:
	G.C. Selesnic
K.J. Burns	United Transportation Union
	Witnesses:
	R. Walker L. Keeler R. Turner P. Young D. Birrell B. Hough
R. Byrnes	Local 1298, United Transportation Union
G. Binsfeld	Ontario Caboose Committee
	Witnesses:
	D.J. Schweitzer V.H. Hamilton
J.E. Taylor	On his own behalf
P.J. O'Driscoll	On his own behalf
D.P. Henry	On his own behalf
D.S. Wiersma	The Canadian Manufacturers' Association
R.J. Long	Local 343, United Transportation Union
J. McNicholl	Township of Georgian Bay
O.C.A. Langmark	Board of Education, City of Toronto

APPENDIX 1 - APPEARANCES

S. Horodyski E. Tandy	Brotherhood of Railway Carmen
P. O'Brien	Alderman, City of London
L. Downey	On his own behalf
R.B. Winsor	Canadian Railway and Transit Manufacturers' Association
J. Burns	Solicitor, Regional Municipality of Niagara
G. Zuters	On his own behalf
F. Gauthier	Councillor, Township of Puslinch
J. Saunders	Emergency Measures Organization Zone Central Nova Scotia
D. Chandler	Bowater Mersey Paper Company Limited
R. Murray	Saint John Port Development Commission
J. Duncan	Brunswick Mining & Smelting Corporation Limited
D. Steele W.E. O'Brien	Locals 304 and 1547, United Transportation Union
D. Slaunwhite	Local 713 United Transportation Union
G.F. Graham	Local 1217 United Transportation Union
G. Murphy	Local 697 Brotherhood of Railway Carmen
R. Douglas	Kraft Limited
L. Piquette	M.L.A., Alberta
R. Marshall D.I. Farrell	Coal Association
J.R. Soulsby	Alberta Economic Development and Trade

APPENDIX 1 - APPEARANCES

J. Samide	Alberta Caboose Committee
	Witnesses:
	R.C. Jordon D. Bewley D. Horne E. McDaid A.H. Bentz A. Cosco P.A. Lindon E.F. Seagris S.A. Bolen G.L. Price B. Lautner W.R. Miller F.J. Cassin
M. Folk	Town of Hinton
D.M. Brownie	Calgary Transportation Authority
R. Spielman	Alberta Fire Fighters Association
N.W. Taylor	M.L.A., Alberta
D. Aitken J. Selby	Alberta Federation of Labour
F.H. Howard	Alberta Intermodal Services Limited
R. Pomeroy R.S. Henan	Dynamic Sciences Limited
R.V. Ennis	Interior Lumber Manufacturers Association
G.E. Bennett	Council of Forest Industries of British Columbia
	Witnesses:
	R.J. Toporowski R.V. Ennis
G.C. Waddell	Fire Chiefs' Association of British Columbia

APPENDIX 1 - APPEARANCES

S. Sanderson	British Columbia Federation of Labour
	Witness:
	F.D. Court
D.J. Kayne	Burlington Northern Railroad
	Witness:
	G. Neswick
W.A. Fomich	Alderman, Municipality of Surrey
P. Lawrence	Vancouver & District Labour Council Committee on Transportation of Dangerous Commodities
	Witness:
	D. Fairey
T. Erskine	British Columbia Professional Fire Fighters Association
J. Langer	Local 1206 United Transportation Union,
	Witness:
	L. Hommen
J.E. Foran	Canadian Pulp & Paper Association and Prairie Pools Incorporated
	Witnesses:
	D.W. Church M.M. Thomas G.S. Arason W. Strath A. McLeod
E.N. McGregor	Local 1070, Dauphin Caboose Committee
	United Transportation Union
	Witnesses:
	T. Lubiniecki

APPENDIX 1 - APPEARANCES

F. Peters	Division 76 Brotherhood of Locomotive Engineers,
H.L. Hosfield	On his own behalf
R. Heath	Canpotex Limited
W. Blaikie L. Benjamin MP	New Democratic Party Caucus, M.P. Winnipeg-Bird's Hill and M.P. Regina West
W. Carlbom	Town of Sioux Lookout
J.F. Roberts	Local 1229, Sioux Lookout Save the Caboose Committee, United Transportation Union
	Witness: B. Otto
Hon. J. Plohman D. Schaefer	Ministry of Highways & Transportation Province of Manitoba
W. Hudson	Manitoba Federation of Labour
	Witnesses: A. Cerilli G. Russell
R.J. Lozenski J.S. Clements	Local 431, United Transportation Union Locals 351 & 1894 United Transportation Union
	Witnesses: B. Harcus J. Colburn B. Hargreaves
H. Grant	Winnipeg Labour Council
	Witness: D.G. Tennant

APPENDIX 1 - APPEARANCES

B. Henry R. Greenaway K. Chorney	Winnipeg Save the Caboose Committee Witnesses: T.B. Benoit D. Huska D. Cox L. Engel G. Conrad R. Ksionzek R. Lang J. Armstrong
L. Duguay	M.P., New Democratic Party, St. Boniface
J.T. Gray	On his own behalf

Appendix 2: COST SAVINGS DETAILS ETIS INVESTMENT AND ETIS OPERATING EXPENSE ESTIMATES

	CN*	CP
A. Front End Units (1)		
No. of Units	1,400	1,070**
Cost ($/millions at $6,500 each)	9.1	7.0
Loco Modifications ($2,200 each)	2.6	2.4
Sub-Total	11.7	9.4
B. Rear End Units (2)		
No. of Units	1,050	675
Cost ($/millions at $7,900)	8.3	5.3
C. Other Capital Costs ($/millions)		
Battery Chargers (3)	0.463	0.086
Batteries (4)	0.848	0.143
Training	0.000	0.075
Sub-Total	1.311	0.304
Grand Total	21.3	15.0

*Source: Exhibit CN-16, Pages 22, 23.

**Source: Exhibit CP-18, Page 5.

(1) Note: CN included 20% backup in number of front end units.

(2) Note: CP and CN differed substantially on price of rear units CP $6,680 (Exhibit CP-18, Page 20), CN $9,135 (Exhibit CN-16, Page 24). Average was taken here.

(3) Note: CP and CN differed substantially on the number of chargers required: CP 170 units (Exhibit CP-18, Page 20) and CN 700 4-slot and 75 16-slot.

(4) Note: CP and CN differed substantially on the number of batteries required: CN 8,400 for 1,050 rear units and CP 1,350 for 675 rear units (likely due to CP not accounting for rear light marker requirements).

Appendix 2: COST SAVINGS DETAILS ETIS INVESTMENT AND ETIS OPERATING EXPENSE ESTIMATES (cont'd.)

Expense Items	Amount $	$/Caboose*
CP Estimates:		
-Front Unit Maintenance	407,948	709
-Rear End Unit Maintenance	1,179,401	2,051
-Replacements-Front	1,531,771	2,664
-Replacements-Rear	982,962	1,709
-Replacements - Loco Equipment	217,825	379
-Replacement & Maintenance Battery Chargers	10,245	18
-Replacement - Batteries	77,990	136
-Total Direct Expenses	4,408,142	7,666
-Variable Overhead Expense	2,216,790	3,855
-Total Operating Expense Estimate	6,624,932	11,522
-Annual ETIS Ownership Cost	1,889,990	3,287
-Grand Total Cost	8,514,922	14,809
CN Estimates:		
-Front Unit Maintenance	224,000	273
-Rear End Unit Maintenance	1,523,000	1,857
-Replacements	not estimated	
-Total Direct Expense	1,747,000+	2,130
-Variable Overhead Expense	not included	
-Total Operating Expense Estimate	1,747,000+	2,130
-Annual ETIS Ownership Cost	6,208,000	7,571
-Grand Total Cost	7,955,000+	9,707

*Note: 575 cabooses for CP and 820 cabooses for CN.

Sources: Exhibit CP-18, Pages 6, 22. Exhibit CN-16, Page 24.

Appendix 2: COST SAVINGS DETAILS ETIS INVESTMENT AND ETIS OPERATING EXPENSE ESTIMATES (cont'd.)

The 5 to 1 ratio between CP's total ETIS operating expense estimates per caboose and that of CN is difficult to rationalize. Barring any other evidence, all that can be said with assurance is that the operating costs of the ETIS will range from $2,130 to $11,522 per caboose removed. The more than 2 to 1 ratio in ownership cost estimates between CN and CP are similarly unexplained. In total, however, the cost estimates for the ETIS equates to between $9,701 and $14,809 per caboose depending on whether one uses CN or CP figures.

Appendix 3: PARTIES WHO WROTE TO THE RTC IN FAVOUR OF REMOVING THE CABOOSE

Organizations in Favour of Removing the Caboose

Alberta Economic Development, Government of Alberta
Atlantic Provinces Chamber of Commerce
Atlantic Provinces Transportation Commission
Board of Trade of Metropolitan Toronto
British Columbia Chamber of Commerce
Business Council of British Columbia
Calgary Chamber of Commerce
Canadian Association of Fire Chiefs Incorporated
Canadian Chamber of Commerce
Fire Chiefs' Association of British Columbia
Halifax Board of Trade
Hamilton & District Chamber of Commerce
Manitoba Farm Business Association
Ontario ministry of Transportation and Communications
Ontario Safety League
Saint John Board of Trade
Saskatchewan Highways and Transportation, J.R. Sutherland
Vancouver Board of Trade
Windsor Chamber of Commerce
Winnipeg Chamber of Commerce

Municipalities in Favour of Removing the Caboose

Glanbrooke, Township of
Kitchener, City of, Business Development Department
Pitt Meadows, District of
Woodstock, Town of

Industries in Favour of Removing the Caboose

Abe Levine & Sons (F'Ton.) Limited
Alberta Wheat Pool
Alcan Aluminum Limited
Algoma Central Railway
Algoma Steel Corporation Limited
A.L.S. Petroleum Service Limited
American Hospital Supply Canada Incorporated
Armco Westeel Incorporated
Atlantic Industries (N.B.) Limited
Atlantic Pressure Treating Limited
Atlantic Waferboard Incorporated
Automobile Importers of Canada
Balfour Forest Products Incorporated
BC Sugar
Boise Cascade Canada Limited
Briquette Dégelis Limitée
Canada Packers Incorporated
Canadian Cattlemen's Association
Canadian Chemical Producers' Association
Canadian Export Association
Canadian Feed Industry Association
Canadian Fertilizer Institute
Canadian Fruit Wholesalers Association
Canadian Industrial Traffic League
Canadian Industries Transportation League
Canadian Manufacturers' Association
Canadian Meat Council
Canadian National Millers Association
Canadian Pool Car Operators Association Incorporated
Canadian Pulp and Paper Association
Canadian Salt Company Limited
Canadian Warehousing Association
Canadian Wood Pallet and Container Association

Canexel Hardboard Incorporated, East River Plant
Canpotex Limited
Cargill Limited
C.F.F.P.C. - Les Entreprises Ferroviaires du Canada Incorporé
Coal Association of Canada Limited
Consolidated - Bathurst Incorporated
Continental Grain Company (Canada) Limited
Crows Nest Resources Limited
Cyclomet - Fers & Métaux Recyclés Limitée
Delebo Incorporated
Dofasco Incorporated
Domglas Incorporated
Domtar Construction Materials
East Coast Lumber Limited
Eastern Bakeries Limited
Edmundston Paper Box Limited
Farfard Peat Moss Company Limited
Flax Growers Western Canada
Fording Coal Limited
Forest Industries of British Columbia, Council of
Fraser Incorporated
General Chemical Canada Limited
Goodfellow Incorporated
Grain Transportation Agency
Grand Falls Agromart Limited
Gregg River Resources Limited
Halifax-Dartmouth Port Development Commission
Haveco Limited
Havelock Lime Works Limited
Havelock Processing Limited
H.J. Heinz Company of Canada Limited
Hudson Bay Mining and Smelting Col., Limited
International Minerals and Chemical Corporation (Canada) Limited
Island Fertilizers Limited
Jiffy Products (N.B.) Limited

Kerr Steamships (Canada) Limited
Kraft Limited
Labatt's New Brunswick Brewery
Lake Ontario Steel Company Limited
Lantic Sugar Limited
Lock-Wood Limited
Lunenburg Foundry and Engineering Limited
Malpèque Fertilizers Limited
Manitoba Pool Elevators
Manitoba Rolling Mills - AMCA International
Maple Leaf Mills Limited
Maritime Paper Products Limited
Mines Gaspé
Mining Association of Canada
Motor Vehicle Manufacturers' Association
Napierville Junction Railway Company
National Gypsum (Canada) Limited
National Sea Products Limited
Neptune Bulk Terminals (Canada) Limited
Niagara Canada - Niagara Regional Development Corporation
Northern Sales Co. Limited
Novacor
Ontario Cattlemen's Association
Palliser Wheat Growers Association
Panval Incorporated
PCS Sales
Petrocanada Bulk Plan
Pioneer Grain Company, Limited
Prairie Pools Incorporated
Prince Edward island Grain Elevators Corporation
Prince Edward Island Potatoes
Ralph S. Plant Limited
Robin Hood Multifoods Incorporated
Rozon Milling (1980) Incorporated
Saint John Port Development Commission

St. Laurence Cement Incorporated
Saskatchewan Wheat Pool
Scotia Investments Limited
Scott Maritimes Limited
Scott Paper Limited
Shell Canada Products Limited
Simplot Chemical Company, Limited
Sonco Steel Tube Limited
Stelco Incorporated
Superior Propane Incorporated
Teck Corporation
Terra Transport
United Grain Growers Limited
United Oilseed Products Limited
Warren Containership Agencies
Westar Mining
Westburne Distribution Services Division
Western Assembly Limited
Western Barley Growers Association
Western Canadian Wheat Growers Association
Weyerhaeuser Canada Limited

Appendix 4: PARTIES WHO WROTE TO THE RTC OPPOSED TO REMOVING THE CABOOSE

Municipalities Opposed to Removing the Caboose

Abbotsford, District of
Adelaide, Township of
Admaston, Township of
Airdrie, City of
Alberton, Township of
Alexander, District of
Alexandria, Town of
Alonsa, District of
Alsask, Village of
Anderdon, Township of
Arcola, Town of
Arthur, Rural Municipality of
Athabaska, County of
Barons, Village of
Battleford, Town of
Belleville, City of
Berwyn, Village of
Bexley, Township of
Big Arm, No. 251, Rural Municipality of
Biggar, Town of
Big Quill No. 308, Rural Municipality of
Big Stick No. 141, Rural Municipality of
Bladworth, Village of
Blind River, Town of
Bloomfield, Village of
Bothwell, Town of
Boulton, Rural Municipality of
Boyle, Village of
Brampton, City of
Brantford, City of
Bredenbury, Town of

Broadview, Town of
Brooke, Township of
Burnaby, District of
Capreol, Town of
Carberry, Town of
Cariboo Regional District
Carmichael No. 109, Rural Muncipality of
Carnarvon, Township of
Castlegard, City of
Chalk River, Village of
Chamberlain, Township of
Chapleau, Township of
Charny, Village of
Chase, Village of
Chateauguay, Ville de
Chisholm, Township of
Churchbridge No. 211, Rural Muncipality of
Churchbridge, Town of
Coburg, Town of
Coldwater, Village of
Cornwallis, Municipality of
Cramahe, Township of
Cranbrooke, City of
Creston, Town of
Daly, Municipality of
Deer Lake, Town of
Delia, Village of
De Salaberry, Rural Municipality of
Drumheller, City of
East Zorra-Tavistock
Eckville, Town of
Edenwold, Rural Muncipality of
Edson, Town of
Elbow, Village of
Elora, Village of

Emerald No. 277, Rural Municipality of
Enniskillen No. 3, Rural Municipality of
Esterhazy, Town of
Estevan, Village of
Etobicoke, City of
Eye Hill, Rural Muncipality of
Fairlight, Village of
Fernie, City of
Fertile Valley No. 285, Rural Municipality of
Fillmore, Rural Municipality of
Fish Creek No. 402, Rural Municipality of
Flamborough, Town of
Flamborough, Township of
Foley, Township of
Forestburg, Village of
Fort Erie, Town of
Fort Frances, Town of
Forty Mile No. 8, County of
Fruitvale, Village of
Gander, Town of
Georgina, Town of
Geraldton, Town of
Gibbons, Town of
Gladstone, Town of
Glenavon, Village of
Goodeve, Village of
Grahamdale, District of
Grand Rapids, District of
Grandview, Rural Municipality of
Grassy Creek No. 78, Rural Municipality of
Grassy Lake, Village of
Grattan, Township of
Grayson, Village of
Grenfell, Town of
Grimsby, Town of

Hamilton, City of
Hanna, Town of
Hantsport, Town of
Harrison, Rural Municipality of
Hilliard, Township of
Hilton, Township of
Hinton, Town of
Horton, Township of
Hullett, Township of
Ignace, Township of
Ingersoll, Town of
Irricana, Village of
Jaffray & Melick, Township of
Jedburgh, Village of
Kamloops, City of
Kamsack, Town of
Keewatin, Town of
Kenora, Town of
Kent, District of
Kent, District of
Kindersley, Town of
King, Township of
Kingsville, Town of
Kinley, Village of
Kitchener, City of
Lac-Mégantic, Ville de
Wakefield, Village of
Lake Lenore No. 399, Rural Municipality of
Lamont, Town of
Lancer, Village of
Langenburg, No. 181, Rural Municipality of
Langley, City of
Leask, Village of
Lethbridge, City of
Lipton, Rural Municipality of

London, City of
London, Township of
MacGregor, Village of
Mackenzie, District of
Maidstone, Township of
Mankota, Village of
Maple Ridge, District of
Mariposa No. 350, Rural Municipality of
Marquis No. 191, Rural Municipality of
Meyerthorpe, Town of
McDougall, Township of
McLennan, Town of
McNab, Township of
Medicine Hat, City of
Meeting Lake No. 466, Rural Municipality of
Melfort, City of
Melville, City of
Mervin, Village of
Metropolitan Toronto, Municipality of
Michipocoten, Township of
Middlesex, County of
Milton, Town of
Minnedosa, Town of
Mississauga, City of
Moncton, City of
Montcalm, Rural Municipality of
Montmartre No. 126, Rural Municipality of
Moore, Township of
Moosomin, Town of
Morinville, Town of
Morley, Township of
Muskoks Lakes, Township of
Naicam, Town of
Nampa, Village of
Neebing, Municipality of

Nelson, City of
Nepean, City of
Newbury, Village of
Newcastle, Town of (New Brunswick)
Newcastle, Town of (Ontario)
New Sarepta, Village of
Niagara, Regional Municipality of
Nickel Centre, Town of
North Battleford, City of
North Burgess, Township of
North Cypress, Municipality of
North Norfold, Municipality of
North Shore, Township of
North Vancouver, City of
North Vancouver, District of
Oak Lake, Town of
Oakville, Town of
Ochre River, Rural Municipality of
Okotoks, Town of
Olds, Town of
100 Mile House, Village of
Orford, Township of
Oshawa, City of
Oxbow, Town of
Oxford, County of
Paisley, Village of
Palmerston, Town of
Pas, the Town of
Petrolia, Town of
Piapot No. 110, Rural Municipality of
Plympton, Township of
Portland, Township of
Port Moody, City of
Port Stanley, Village of
Prince Albert No. 461, Rural Municipality of

Prince George, City of
Provost, Town of
Punnichy, Village of
Puslinch, Township of
Rama, Township of
Rayside-Balfour, Town of
Red Deer, City of
Regina, City of
Revelstoke, City of
Ritchot, Municipalité Rurale de
Robsart, Village of
Rochester, Township of
Rockwood, Rural Municipality of
Romney, Township of
Rosser, Rural Municipality of
St. Benedict, Village of
St. Clair Beach, Village of
St. Walburg, Town of
Saltcoats, Town of
Sandwich South, Township of
Sandwich West, Township of
Sarnia, City of
Sasman No. 336, Rural Municipality of
Schreiber, Township of
Semans, Village of
Shedden, Improvement District of
Sidney, Township of
Sioux Lookout, Town of
Slave Lake, Town of
Smiths Falls, Town of
Smooth Rock Falls, Town of
Souris, Town of
South Dumfries, Township of
Sparwood, District of
Springfield, Village of

Stratford, City of
Surrey, District of
Swan River, Town of
Sydney, City of
Tay, Township of
Tecumseth, Township of
Tehkummah, Township of
Thessalon, Town of
Thorold, City of
Tofield, Town of
Toronto, City of
Tottenham, Village of
Trail, City of
Trenton, City of
Tuxford, Village of
Vancouver, City of
Vaughan, Town of
Vegreville, Town of
Veregin, Village of
Vermilion, Town of
Virden, Town of
Wabamun, Village of
Walden, Town of
Warburg, Village of
Watford, Village of
Watrous, Town of
Watson, Town of
Weyburn, City of
Wicksteed, Township of
Village of Wilcox
Wolverine No. 340, Rural Municipality of
Woodstock, City of
Wynyard, Town of
Wyoming, Village of
York, City of

Organizations Opposed to Removing the Caboose

Alberta Federation of Labour
Algoma District Municipal Association
Amalgamated Transit Union, Local 107
Aquasar International Limited
Brandon Professional Fire Fighters' Association
Brewery, Winery and Distillery Workers, Local 300
British Columbia Provincial Caboose Committee
Brotherhood of Locomotive Engineers, Division 667
Calgary Labour Council
Canadian Association of Fire Fighters
Canadian Council of Railway Shopcraft Employees and Allied Workers
Canadian National System Federation (Western Lines)
Canadian Pacific Pensioners Association
Canadian Railway Historical Association
Canadian Railway Labour Association
Canadian Union of Postal Employees
Canadian Union of Postal Workers
Canadian Union of Public Employees
Carleton Place Fire Department
Central Kootenay Union Board of Health
Chapleau CP Pensioners Association
Communications Workers of Canada, Local 42
Energy and Chemical Workers Union
International Association of Machinists and Aerspace Workers
Kenora-Keewatin and District Labour Council
Ladies Auxilliary of the United Transportation Union
Manitoba Department of Highways and Transportation
Manitoba Federation of Labour, Canadian Labour Congress
Meadow Highlands Mobile Home Cooperative
M-TRAC
National Council of Women of Canada
National Railway Labor Conference, Economic Research Department
North Bay and District Labour Council

Ontario Association of Police Chiefs
Ontario Caboose Committee
Ontario Legislative Board of the United Transportation Union
Sarnia Professional Fire Fighters' Association
Saskatchewan Association of Rural Municipalities
Saskatchewan Legislative Committee, Canadian Railway Labour Association
Shuswap Nation Tribal Council
Transcona Federated Crafts, Western Region Federation
Transport 2000
Union of British Columbia Indian Chiefs
United Electrical, Radio and Machine Workers of Canada
United Foods and Commercial Workers International Union
United Steelworkers of America, Locals 1105, 7135 and 7184
United Transportation Union
Vancouver Firefighters Union, Local 18
Watson and District Chamber of Commerce
Whispering Pines Indian Band

Individuals Opposed to Removing the Caboose

Allen, H.D.
Arcand, J.G.
Ariss, Anne
Baglole, William J.
Bailey, W.B.
Bartlett, F.S.
Baxter, Robert G.
Bell, Don
Benta, Trevor R.
Birch, Gerald - Fire Chief, Birtle Volunteer Fire Department
Braun, Alan G. - North Battleford Fire Fighters Association
Buckley, M.A.
Burghardt, Jack - M.P., London West
Carew, C.W.
Champagne, Elizabeth
Coates, Robert C. - M.P., Cumberland-Colchester
Corbett, R.A. - M.P., Fundy-Royal
Corbin, Roger J.
Cormier, L.W.
Crouse, Lloyd, R. - M.P. South Shore
Cummins, Dewey
Curll, B.E.
Currie, D.J.
Darling, Stan - M.P. Parry Sound-Muskoka
de Jong, Simon - M.P. Regina East
Desrosier, A.D.
Doherty, Don - Fire Chief, Souris Fire Department
Downey, Lorne
Drysdale, D.H.
Elson, Harvey W.
Evans, J.L.
Fecho, Charlene
Fecho, Harold

Ferguson, R.W.
Ferretti, A.
Fioravanti, Peter
Foisy, O.J.
Frazell, K.E.
Friesting, Brian D.
Frith, Douglas C. - M.P., Sudbury
Geiler, D.W.
Genrick, Don
Gervais, Aurele - M.P., Timmins-Chapleau
Gordon, James K. - M.P.P., Sudbury
Gosselin, Lucie
Gosselin, Serge
Graham, Gary F.
Halpape, Louise
Halpape, Stephanie
Harrison, Robert E.
Harrison, Terry
Harvey, R. Bruce
Henophy, F.A.
Hockin, Tom - M.P.
Illife, Richer - Town of Haldimand Fire Department
Ireland, W.R.
Jackson, Blair D. - Chief of Policy, City of Halifax Police Dept.
Johnson, William W.
Keene, Steven B.
Kelly, John M.
Kemp, Dave - Chief, Niagara Falls Fire Department
Kilgour, David - M.P., Edmonton Strathcona
Kuchynski, S.P.
Laughren, Floyd - M.P.P., Nickel Belt
Lawrence, R.W.
LeBel, Raymond
Leclair, Diane

Lecuyer, Gerald - Minister, Manitoba Minister of Environment and Workplace Safety and Health
Leech, John
Lelland, Janice L.
Lepitre, John
Léveillé, Serge
Lockyer, Douglas W.
Lorraine, Edward F. - MLA, Colchester North
MacIsaac, Jack - Department of Transportation, Nova Scotia
MacLellan, Mary
MacLeod, Don
Manning, Senator Richard E. - Montana State Senate
Martel, Elie - M.P.P., Sudbury East
Martin, Chas. P.
Martin, Nick E.
Maslak, P. (for London residents)
Masters, Jack - M.P., Thunder Bay-Nipigon
Mattatall, H.K.
McDiarmid, Robert
McDevitt, Roger
McDuffe, D.V.
McGraw, Maurice G.
McKinney, Gerry
Miller, Gordon I.
Morrison, D.G.
Morrison, Edward J.
Morrison, Harold
Murray, R.
Murtland, D.
Newell, Rick
Nodge, R.
Novak, T.
Nova Scotia (Residents of)
Oliver, Clifford A.
Oliver, Wayne B.

O'Neill, J. - Alderman, Billings Ward, City of Ottawa
Pilkington, S.F.
Plant, Ernie Les
Plaut, Walter W.
Plohman, John S.
Poppe, Lois M.
Pouliot, Gilles - M.P.P., Lake Nipigon
Rae, Bob
Ramage, James B.
Rea, Gladys
Redding, Phil
Rep, P.
Riemer, Audrey
Riemer, Stuart
Riis, Nelson A. - M.P., Kamloops Shuswap
Robinson, B.
Robinson, David M.
Robinson, Roger J.
Rosenfelt, N.
Roy, André
Rush, Maurice - B.C. Leader - Communist Party of Canada
Scarrow, W.G.
Schofield, Joseph
Scheweitzer, D.J.
Shurvell, G.V.
Sioux Lookout (Citizens of)
Skelly, Raymond - M.P., Comox-Powell River
Slade, Wm. A.
Spodofov, Carmen
Stokes, Jack - M.P.P., Lake Nipigon
Stroesser, Curtis
Stroesser, Tanya
Tebb, N.S.
Terry, Saul
Thideman, Ruth

Thoms, Gordon

Turner, Hon. Charles - Senator, The Senate of Canada

Van Impe, B.

Vine, C. Norman - Assistant Chief, Fire Advisory Services, Office of the Fire Marshall, Ontario Ministry of the Solicitar General

Vogler, Bryan

Waldie, Chief Wm. G. - Cartwright Robin Volunteer Fire Department

Walker, Michael - Alderman - Ward 10, Toronto

Watt, John W.

Weaymouth, Terry

Weir, J.

West, H.C. - West and Associations

Wilkinson, Al

Winters, L.W.

Witty, Glen

Young Peter J.

Appendix 5: RAILWAY SAFETY MEASUREMENT DATA

Measures of Current Level of Railway Safety

This table presents a measure of a system-wide injury frequency for CN and CP which reflects to some degree the current level of railway safety.

INJURY FREQUENCY

(1984/85)

Cause	CN		CP	
	Injury	Death	Injury	Death
1. Derailment	26	1	20	1
2. Collision	89	0	30	0
3. Crossing	333	86	255	39
Total	448	87	305	40

Source: RTC Records.

In order to compare the injury/death frequency figures of one railway to another on equal footing those figures must be normalized by some factor which fairly represents the frequency of opportunity for accident. One such factor is the number of train-miles performed, another is the number of ton-miles carried. The former criteria is the most sensible to use as the number of ton-miles carried does not relate to the frequency of accidents as does the number of train-miles performed. The data in the above table is represented in a normalized fashion in the following table:

NORMALIZED INJURY FREQUENCY

(per million train-miles)

(1984/85)

Cause	CN		CP	
	Injury	Death	Injury	Death
1. Derailment	0.27	0.02	0.25	0.00
2. Collision	0.64	0.00	0.62	0.00
3. Crossing	3.80	0.82	5.42	0.62

Source: Current RTC Records based on total train-miles for 1984/85 of 91.3 for CN and 55.7 for CP.

The foregoing indicates an existing level of safety in terms of the product of railway accidents by basic accident types as normalized by the number of train-miles performed. When one wishes to determine the principle causes of those deaths and injuries so as to find ways to reduce the risk to the public and to employees, it is necessary to evaluate the frequency of derailments, collisions and crossing accidents. This, in itself, is a secondary measure of the level of safety. An example follows in the next table.

ACCIDENT FREQUENCY

(1984/85)

Cause	Number		Number/Million Train-Miles	
	CN	CP	CN	CP
1. Derailment	325	180	3.56	3.23
2. Collision	123	50	1.35	0.90
3. Crossing	682	458	7.47	8.22
Total	1,130	688	12.38	12.35

Source: Current RTC Records based on total train-miles for 1984/85 of 91.3 for CN and 55.7 for CP.

In order to further examine the cause of the railway death and injury statistics, a tertiary safety measure is required: that being the identification of the cause of accidents. An example for derailments and collisions follows:

DERAILMENT AND COLLISION CAUSES

(1984/85)

Cause	Total	%
A. Derailments		
-Track Related	198	36.1
-Equipment Related	133	24.2
-Operations Related	98	17.9
-Other	92	16.8
-Undetermined	27	4.9
-Total	548	100.0
B. Collisions		
-Track Related	-	0.0
-Equipment Related	5	2.9
-Operations Related	163	93.7
-Other	4	2.3
-Undetermined	2	1.1
-Total	174	100.0

Source: "An Examination of Canadian Railway Derailments and Collisions" an RTC report to the Minister dated March 26, 1986.

A further breakdown of cause is possible as well which brings the data down to a point where specific corrective action can be identified:

CAUSES OF DERAILMENTS
(1984-1985)

Cause	Number	%
A. Track Related		
-Snow, Ice, Mud	23	4.2
-Slides, Unstable Slopes, Subsidence	12	2.2
-Washouts, Floods	6	1.1
-Rail Buckle	18	3.3
-Rail Rollover	8	1.5
-Gage Restraint	20	3.6
-Broken Rail/Joint	47	8.6
-Other Track Failure	5	0.9
-Track Geometry	42	7.7
-Defective Turnout	17	3.1
Total	198	36.1
B. Equipment Related		
-Loose Wheels	3	0.5
-Broken Wheels	19	3.5
-Broken Axles	10	1.8
-Roller Bearing Failure	41	7.5
-Friction Bearing Failure	15	2.7
-Truck Defect	13	2.4
-Brake Gear Defect/Dragging	16	2.9
-Draft Gear Failure	7	1.3
-Other Defect	9	1.6
Total	133	24.3
C. Operations Related		
-Rule Violations	59	10.8
-Other Employee Failure	25	4.6
-Train Control/Marshalling	14	2.6
Total	98	17.9
D. Miscellaneous		
-Loading Defects	30	5.5
-Vandalism	24	4.4
-Combination Track/Equipment/ Operations	38	6.9
-Undetermined	27	4.9
Total	119	21.7
Grand Total	548	100.0

Source: "An Examination of Canadian Railway Derailments and Collisions" RTC report to the Minister dated March 26, 1986.

The causes of collisions may also be categorized in more detail as follows:

CAUSES OF COLLISIONS

Cause	Number	%
A. Employee Related		
-Crew Communication Deficiency	19	10.9
-Improper Handling of Switches or Derails	21	12.1
-Improper or Insufficient Brake Applications	42	24.1
-Improper positioning of car or movement	35	20.1
-Excessive Speed	37	21.3
-Other	9	5.1
-Total	163	93.7
B. Equipment Related	5	2.9
C. Vandalism	4	2.3
D. Undetermined	2	1.1
TOTAL	174	100.0

Source: "An Examination of Canadian Railway Derailments and Collisions". An RTC report to the Minister dated March 26, 1986.

The detailed causes of derailment and collisions reflect those things that cannot apparently be eliminated by current preventative procedures. They result in accidents which similarly cannot apparently be prevented under current conditions. Those accidents occur and those causes exist with the caboose in place and with a crew member located at the end of the train. It follows then that those accidents, by those causes, would have existed with or without the caboose and a crew member in place at the end of the train — all other things being equal.

The foregoing data are of no direct use therefore in determining what the impact on safety would be if, for instance, the caboose was removed and the rear crew relocated to the lead locomotive cab. What the data does offer, in this restricted concern, is an indication of the level of safety that is considered adequate by the UTU and which exists with the caboose and rear crew member in place.

Appendix 6: GENERAL SURVEY INCIDENT CATEGORIES

General Survey Incident Categories

1. Detection of hot boxes or dragging equipment not detected by wayside equipment.

2. Detection of sticking brakes.

3. Detection of leaking cars or containers containing dangerous commodities.

4. Detection of mechanical defects on cars not detected during terminal standing or pull-by inspection.

5. Train struck vehicle at road crossing at grade.

6. Detection of shifted or protruding loads and loose strapping or bracing material not detected at terminals during standing or pull-by inspection.

7. Broken rails, sun kinks, washouts or other damage to the track and structure.

8. Fires on or adjacent to the right-of-way.

9. Spring switches which do not return to normal position after a train has trailed through.

10. Instances of improper or non-placarding of dangerous commodity shipments not detected at initial terminal.

11. Improper marshalling of cars in trains not detected at initial terminal.

12. Instances of delay in cutting crossings and compliance with UCOR 103 Paragraph 3.

13. Instances where trains had to be cut at crossings to permit the passage of emergency vehicles.

14. Instances where trains are disabled or stopped by emergency application of the brakes where UCOR 102 requires protection on adjacent tracks.

15. Instances where trains had to be operated in reverse for long distances and where difficulty is experienced applying Paragraphs 1 and 2 of UCOR 103.

16. Incidents where rear crew provided assistance to accident victims where the same assistance could not have been provided by head end personnel or other witnesses.

17. Vehicle struck the side of the train at road crossing at grade.

18. Loss of braking capability at head end where rear crew had to apply brakes in emergency (to avoid an accident).

19. Incidents where the front ETIS unit registers the appropriate decrease and increase in brake pipe pressure during a No. 2 brake test but where the rear car brake shoes are observed not to apply and release as required.

20. Observance of dangerous conditions on passing trains.

21. Visual signals received from the public or employees where it was not possible to communicate by radio when necessary to stop train or report a dangerous condition.

22. Use of radio in caboose when all head end radios have failed.

23. Engine failure during inclement weather resulting in the caboose being the only adequate shelter.

24. Observation of special cars placed in close proximity to the caboose (specify location).

25. Instances where trains came apart on bridges without walkways and where there is a need to apply hand brakes on the rear portion of the train and this cannot be accomplished by the head end crew.

26. Other incidents not listed above or in Categories No. 27, 28, 29.

27. Hot box and dragging equipment detectors inoperative or failure.

28. Radio defects or failures.

29. Brake pipe pressure air continuity problems.

30. Other incidents not listed above and invalid due to:

    a) not first detected by rear crew, or
    b) not a safety-related incident.

Source: Exhibit CTC-1D Appendix B